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RETIREMENT IN FOUR PROFESSIONS
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CONTENTS *and* CONTRIBUTORS

J. F. FAZEKAS, A. N. BESSMAN, N. J. COTSONAS, JR., AND R. W. ALMAN, *Cerebral Hemodynamics in Cerebral Arteriosclerosis*

Dr. Fazekas is Chief of Staff at Gallinger Municipal Hospital, Washington, D. C., and is also associated with the departments of medicine of George Washington, Georgetown, and Howard Medical Schools. Dr. Fazekas was graduated from Albany Medical College in 1944. In addition to his basic interest in cerebral physiology, he devotes much time to problems relating to geriatric medicine and rehabilitation.

Dr. Bessman received her M.D. degree from George Washington University in 1948. Following her internship and residency in medicine at George Washington University Hospital, she served a research fellowship in medicine at Gallinger Municipal Hospital. At present, she is a research fellow in pediatrics at Massachusetts General Hospital.

Dr. Cotsonas, Jr. received his M.D. degree from Georgetown University in 1943, and served his internship and residency in medicine and pulmonary diseases at Gallinger Municipal Hospital. At present he is Chief Medical Officer, Department of Medicine, Gallinger Municipal Hospital, and Assistant Professor of Medicine, Georgetown University.

Dr. Alman received his M.D. degree from Georgetown University in 1946. Following his internship and residency in medicine at Cambridge City Hospital, he served as a resident in medicine at Gallinger Municipal Hospital and later as Chief Medical Officer, Outpatient Department. At the present time he is engaged in the private practice of medicine in Cambridge, Massachusetts.

This article reports the effects of various vasoconstrictor and dilating agents on the flow and distribution of blood in the brain of elderly subjects. The findings indicate that in the presence of arteriosclerosis of the blood vessels of the brain with or without high blood pressure, these blood vessels are capable of at least partial relaxation and, conversely, may undergo a further increase of tonus in response to appropriate stimuli.

G. W. CASARETT, *Obstructive Pulmonary Emphysema and Bronchial Obstruction by Lymphatic Tissue in Aging Rats*

Dr. Casarett is scientist and assistant chief of the Radiation Tolerance Section, Department of Radiation Biology, University of Rochester School of Medicine and Dentistry, Rochester, New York. Dr. Casarett has been engaged in experimental investigation of the pathologic effects of radiation since 1943 at the University of Rochester.

This article reports the development of a condition in which the normal air spaces of the lungs are increased by obstruction of the small air passages (obstructive pulmonary emphysema) with advancing age in rats, apparently independent of infections in the lungs. Histologic studies of sections taken throughout such emphysematous lungs revealed obstruction of the small air passages caused by insheathing of nodules of excessively growing lymphatic tissue surrounding the air sacs in the lung. This condition seemed to develop after the age of 18 months. The data indicate that the excessive growth of lymphatic tissue observed is a cause of pulmonary emphysema in aging rats and suggest that the greatly increasing incidence of severe lung infection in aging rats after the age of 18 months may well be related to the predisposing condition of the obstructive pulmonary emphysema described.

J. E. KIRK AND P. FROM HANSEN, *The Presence of Carbonic Anhydrase in the Media of the Human Aorta*

Dr. Kirk is Director of Research of the Division of Gerontology, Washington University School of Medicine, St. Louis. At the time the study was car-

ried out Dr. From Hansen held the position as Research Assistant in the same department.

Using both a colorimetric and manometric technique the authors were able to demonstrate the presence of carbonic anhydrase in homogenates prepared from samples of human aortas. The significance of this enzyme for the metabolism of arterial tissue is discussed.

W. S. Hartroft, *Pathogenesis and Significance of Hemoceroid and Hyaloceroid, Two Types of Ceroidlike Pigment Found in Human Atheromatous Lesions*

Dr. Hartroft is professor in charge of experimental pathology and histology in the Banting and Best Department of Medical Research at the University of Toronto, Canada. He was awarded the annual prize for research in 1949 which is presented by the Royal College of Physicians in Canada. He is also a consultant in the Department of Pathology, University of Toronto.

The author reports the presence of an alcohol-insoluble pigment which is stained by sudan in atheromatous lesions in the aorta, coronary arteries and other vessels in human autopsy material. This material resembles the pigment, ceroid, which is found in the fibrous bands of cirrhotic livers of choline-deficient rats. The sudanophilic pigment in human atheromatous lesions can be differentiated, on morphologic grounds, into two types which the author has named *hemoceroid* and *hyaloceroid*. It is suggested that these pigments arise by interaction of fat and red blood cells or hyaline tissue, respectively. This hypothesis is supported by experimental results obtained in dogs' aortas.

R. A. Luce, Jr. and D. Rothschild, *The Correlation of Electroencephalographic and Clinical Observations in Psychiatric Patients Over 65*

Dr. Luce is senior physician and electroencephalographer at Worcester State Hospital where Dr. Rothschild is clinical director.

Clinical and electroencephalographic observations on 110 patients 65 years of age or over were studied. The most frequent electroencephalographic abnormality was the slowing of the dominant rhythm to a frequency of less than 8 per second. The three most reliable factors for quantitatively evaluating the severity of the clinical symptoms in this age group seemed to be stream of talk, orientation, and memory. The disturbances of these functions exhibited a direct relationship with electroencephalographic abnormalities in 90 per cent of the cases studied.

A. M. Brown, *Surgical Restorative Art for the Aging Face. Notes on the Artistic Anatomy of Aging*

Dr. Brown is the director of the Chicago School of Plastic Surgical Prosthetics. He is a former associate in plastic surgery at the Eye and Ear Infirmary of the University of Illinois, Chicago, and is the head of the Plastic Surgery Department of the Edgewater Hospital in Chicago.

For the past fifteen years, the author has been dealing with psychic and somatic problems of the aging face. This paper discusses the theories of optics and of art as applied to the aging face and describes the gross anatomic changes in appearance as age advances. The author describes the technique of the face lift in removing facial wrinkles, the shortening of the nose as a facial rejuvenating procedure, and the ablation of bagginess of the eyelids as a surgical procedure to effect optical rejuvenation for the aging face.

W. R. Miles and B. M. Shriver, *Aging in Air Force Pilots*

Dr. Miles is Professor of Psychology at Yale University and is Chairman of the Board of Directors of the American Institute for Research. He was research advisor of this study. Dr. Shriver is a member of the research staff of the Institute and was project director of the study.

This article summarizes an investigation of the types of change with age reported by aircrewmen of the U. S. Air Force. Over 800 active crew personnel were asked to cite instances of improved or lessened job proficiency which they had observed, in themselves or other aircrewmen, to have occurred with increase in age. The most prominent type of deterioration reported was loss of physical ability to meet job needs. Other symptoms of aging, both effective and ineffective, fell in general areas of change in: (1) motivation and ability to improve in skill; (2) on-the-job performance; (3) quality of relationships with others; (4) motivation and adjustment with respect to job.

These areas were broken down into homogenous sub-categories; those persons showing ineffective behaviors falling in one of the sub-categories were generally older than those persons becoming more effective in the same general class of activity.

K. W. Schaie, F. Rosenthal, and R. M. Perlman, *Differential Mental Deterioration of Factorially Pure Functions in Later Maturity*

At the time these studies were conducted, Mr. Schaie and Mr. Rosenthal were research assistants at the Institute of Endocrinology and Gerontology in San Francisco. Dr. Perlman is the director of this Institute. Mr. Schaie is now a graduate student in psychology at the University of Washington, Seattle, and Mr. Rosenthal at Stanford University.

The authors found that "factorially pure" mental functions decline at different rates with increasing age. A group of 61 subjects, aged 53 to 78, were given the Thurstone Primary Mental Abilities Test

under two conditions. In the first instance, time limits were imposed, in the second, no time limits were set, and the results gave an index of power. The factors of space and reasoning abilities were found to decline much faster than number, verbal-meaning, and word-fluency when the time limit for completing each test was removed. The reliabilities of the various tests were high in the aged group and the "pure" factors isolated by the statistical analysis were relatively independent of one another.

A. E. GRAVATT, *Family Relations in Middle and Old Age. A Review*

Mr. Gravatt is at present a graduate student at Cornell University and a fieldworker with *Cornell Studies in Social Growth*. He received his Master of Arts degree at the University of Oregon in 1951.

A review of the findings of research concerning the family during later maturity constitutes the major portion of the article. Theories of personality adjustment in this period are also summarized. The author concludes that empirical studies and theories of adjustment in the later stages of family life are inadequate for an understanding of family relations during this period. Rather than solve the problems they pose, the studies and theories reported have crystallized the need for longitudinal studies of personality development and adjustment from childhood to old age.

T. A. MAHONEY AND T. R. LINDBOM, *Practices of Minneapolis Firms in the Utilization of Older Employees*

Mr. Mahoney is research fellow on the staff of the Industrial Relations Center of the University of Minnesota. At the time this study was conducted, Mr. Lindbom was project supervisor on the staff of the Industrial Relations Center. Mr. Lindbom is now training director for Midland Cooperative Wholesale, Minneapolis.

This article reports the findings of a study of personnel policies and practices concerning handicapped older employees in 34 Minneapolis firms. No formal policy was found for utilization of older employees when they encountered difficulty handling their usual jobs. Rather, each case of utilization was handled individually. Comparison of the informal methods of utilization used in these firms with similar findings of studies in 1933 and 1947 reveals that there has been little change in management policies and practices affecting utilization in the intervening years. The immediate supervisor, plant nurse, and industrial physician play key roles in the informal utilization processes of the firms studied.

D. O. MOBERG, *Church Membership and Personal Adjustment in Old Age*

Dr. Moberg is chairman of the Social Science Department and Assistant Professor of Sociology at Bethel College, St. Paul, Minnesota.

The author analyzed data secured by the use of questionnaires from 219 institutionalized persons aged 65 and over. *Ex post facto* experimental designs were applied to equate individuals who were church members with those who were not church members on the basis of background characteristics. Initial differences in personal adjustment between groups of church members and non-members were eliminated by increasing the precision of control in matching the two groups. The control of past church membership experience of the non-members did not significantly modify this finding. It is therefore concluded that other studies which have found church affiliation to be related to good personal adjustment in old age probably have done so only because church membership is correlated with religious activities and religious beliefs which are significantly related to good personal adjustment in old age.

E. SHANAS AND R. J. HAVIGHURST, *Retirement in Four Professions*

Dr. Shanas is director of research in the Mayor's Housing and Redevelopment Coordinator's Office, Chicago, and formerly director of research for the Committee on Study of Later Maturity, the University of Chicago. Professor Havighurst is chairman of the Committee on Human Development at the University of Chicago.

The authors have made a questionnaire study of four groups of older professional men: public school teachers, Methodist ministers, Young Men's Christian Association secretaries, and physicians. Nearly all of the men were 65 years of age and older, and all of the first three groups were nominally retired from their life-time employment. The average ages of these men ranged from 70 years for the YMCA secretaries to 75 for the ministers.

The sample of YMCA secretaries was the most representative, since 77 per cent of a group of retired secretaries scattered across the country responded. The sample of Methodist ministers was also drawn from the whole country, but only 39 per cent responded to the questionnaire. The public school teachers and physicians were drawn from the Chicago area, with 60 per cent and 38 per cent responding to the questionnaire.

More than half of the men (56 per cent) were still employed full or part time, though, with the exception of the physicians, they were nominally retired. Their employment ranged over a wide variety of occupations. The proportion working full time ranged from 16 per cent of the ministers to 38 per cent of the physicians. Continued work after the nominal retirement age was not found to be related either to economic necessity or a desire to fill "empty time." Work has positive meanings to these professional men, and most of them do not stop work if they can avoid it.

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Cerebral Hemodynamics in Cerebral Arteriosclerosis

JOSEPH F. FAZEKAS, ALICE N. BESSMAN, NICHOLAS J. COTSONAS, JR., AND RALPH W. ALMAN

RECENT observations, employing the nitrous oxide technique (9) for measuring cerebral blood flow, indicate that the cerebral vessels of the normal healthy population (below 50 years of age) are capable of undergoing appreciable changes in their diameter. These changes are demonstrated by alterations in cerebral vascular resistance during administration of various cerebral vasodilating (1, 4, 5, 13, 16) or vasoconstricting agents (17, 11), and accompanying changes in posture (14, 15), arterial blood pressure (1, 2, 7), or blood gas concentrations (3, 8, 10).

The question of whether the cerebral vessels of subjects with cerebral arteriosclerosis are likewise capable of constricting or dilating in response to appropriate stimuli has not previously been adequately investigated. In the present study cerebral hemodynamics and oxygen consumption of persons over 50 years of age having cerebral arteriosclerosis with or without hypertension were studied before and during the administration of carbon dioxide or aminophylline and during hyperventilation.

METHOD

Scheinberg and Stead's (14) modification of Kety and Schmidt's (9) procedure for the determination of cerebral blood flow (CBF) was applied in this study. The gas mixtures utilized were those described by the latter authors (10). Blood oxygen was determined by the manometric technique of Van Slyke and Neill (12). Mean arterial blood pressure (MBP) was obtained directly from the femoral artery by means of a damped anaeroid manometer. The cerebral oxygen consumption ($CMRO_2$), cerebral vascular resistance (CVR), and cerebral oxygen delivery (CDO_2) were calculated as follows: $CMRO_2$ (cc. O_2/min./100 gm. brain) $= \frac{CBF \times (A\text{-}V)\ O_2}{100}$; CVR (mm. Hg./cc. blood/min./100 gm. brain) $= \frac{MBP}{CBF}$; CDO_2 (cc. O_2/min./100 gm. brain) $= \frac{CBF \times \text{arterial } O_2}{100}$ where arterial O_2 signifies arterial oxygen content — cc. O_2 per 100 cc. of blood.

The subjects in this investigation, all 50 years of age or over, had clinical evidence of cerebral arteriosclerosis in accordance with either or both of the following criteria: (a) old or recent cerebral vascular accident; (b) cerebral depression or confusion with eyeground changes characteristic of arteriosclerotic retinopathy, Grade II or more. Mean arterial blood pressure levels up to 110 mm. Hg. were considered within normotensive limits; determinations consistently at or above this value were regarded as hypertensive.

In 13 normotensive and 17 hypertensive subjects, immediately after control determinations were performed the administration of 5 per cent CO_2 was instituted for ten to fifteen min-

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utes and continued during the additional ten-minute period required to determine again the cerebral blood flow. In 17 other subjects (9 normotensive, 8 hypertensive) 0.5 gms. of aminophylline in 250 cc. of physiological saline were administered intravenously over a period of thirty minutes following the control determination; during the final ten minutes of this period, the second or experimental cerebral blood flow determination was performed. Eight normotensive and 7 hypertensive subjects, in whom the effects of hyperventilation were studied, voluntarily respired deeply at a rapid rate for a total period of fifteen to twenty minutes following the control flow determination, including the ten-minute period for the experimental flow determination.

Results

Tables 1 and 2 present the control values in all studies of 22 normotensive and 31 hypertensive subjects, all of whom were 50 years of age or older with clinical evidence of cerebral vascular disease. The mean values obtained show a marked reduction of cerebral blood flow, metabolic rate, and oxygen delivery from values noted previously (3, 9, 14) for subjects below 50 years of age with no evident cerebral vascular disease. The cerebral vascular resistance was markedly increased in both of the older groups as compared to the values noted for younger subjects. Except for blood pressure the only significant difference between the normotensive and hypertensive arteriosclerotic subjects was the greater cerebral vascular resistance in the latter group, a value derived mathematically from the similar mean cerebral blood flow in the presence of a higher average mean arterial blood pressure.

Tables 3 and 4 compare the effects of 5 per cent CO_2 inhalation on cerebral hemodynamics and oxygen consumption in 13 normotensive subjects and 17 hypertensive subjects. In both groups there resulted a significant increase in cerebral blood flow and an increase in oxygen delivery and mean arterial pressure. There was a decrease in cerebral vascular resistance but no change in overall cerebral oxygen consumption. (In both groups a significant increase in cerebral oxygen consumption during CO_2 administration was confined to those subjects having cerebral oxygen delivery rates be-

Table 1. Control Values for Elderly Normotensive Subjects.

Age	CBF*	CVR	$CMRO_2$	CDO_2	AO_2	MBP
93	29.2	2.8	1.9	3.5	12.08	83
93	43.9	2.1	2.1	4.5	10.26	93
73	31.4	3.3	2.4	5.0	15.89	103
73	32.8	2.4	2.5	5.0	15.35	79
73	30.4	3.4	2.1	4.8	15.83	107
86	40.0	2.3	1.4	3.8	9.58	93
60	31.6	2.3	2.6	4.6	14.47	83
56	31.9	3.1	1.6	4.7	14.75	100
68	33.6	2.5	1.9	4.0	11.94	85
75	44.8	1.9	2.6	5.4	11.97	84
102	35.4	2.5	1.6	3.7	10.44	88
102	20.7	4.4	1.5	2.8	13.61	92
82	38.3	2.8	2.6	5.0	12.98	107
62	50.7	1.8	2.6	6.1	11.99	89
60	33.5	2.7	2.5	5.0	14.98	91
73	25.5	3.8	2.2	4.4	17.11	96
66	29.9	2.8	1.4	3.0	10.05	83
50	29.6	3.3	2.7	5.6	18.80	98
75	63.6	1.4	1.5	2.7	4.20	89
89	31.9	3.0	1.9	4.3	13.37	96
91	44.1	2.0	2.3	6.3	14.29	90
72	42.7	2.5	1.8	4.8	11.29	108
78	32.0	2.7	2.3	4.9	15.25	86
78	34.2	2.6	2.1	5.1	14.78	89
63	36.4	2.9	2.1	6.7	18.52	105
70	32.5	3.0	1.7	4.5	13.97	98
			Mean Values			
74	38.1	2.6	2.5	4.6	13.15	93
Mean Values of Normotensive Subjects Below Age 50						
34	54.2	2.1	3.5	8.1	14.72	<110

* In this and other tables, CBF signifies cerebral blood flow in cc./min./100 gm. of brain; CVR, cerebral vascular resistance in mm. Hg./cc. blood/min./100 gm. of brain; $CMRO_2$, cerebral oxygen consumption in cc./min./100 gm. of brain; CDO_2, cerebral oxygen delivery in cc./min./100 gm. of brain; AO_2, arterial oxygen content in cc. O_2/100 cc. of blood; MBP, mean arterial blood pressure in mm. of Hg.

TABLE 2. CONTROL VALUES FOR ELDERLY HYPERTENSIVE SUBJECTS.

Age	CBF	CVR	$CMRO_2$	CDO_2	AO_2	MBP
79	33.2	3.7	2.3	5.0	14.98	123
69	42.9	2.7	2.5	6.0	14.05	115
67	38.4	3.3	2.8	5.7	14.72	125
58	33.2	3.3	1.6	4.2	12.71	110
60	43.3	3.8	2.5	6.3	14.57	165
75	51.8	2.3	2.8	8.1	15.72	120
67	35.3	3.3	3.2	5.4	15.38	118
65	39.5	3.1	2.1	5.0	12.67	123
62	40.1	3.6	3.2	6.7	16.80	143
62	46.8	2.7	3.3	7.2	15.28	125
73	58.2	2.1	3.6	8.3	14.21	125
81	39.0	3.2	2.2	4.8	12.31	124
81	48.0	2.4	3.8	5.9	12.27	115
51	50.0	2.4	2.7	7.2	14.43	121
60	29.6	4.8	0.6	4.7	15.95	143
60	32.4	3.6	1.5	4.7	14.59	117
53	46.3	2.7	1.9	5.8	12.60	123
70	34.8	4.2	1.0	4.2	12.15	145
66	31.9	3.9	2.8	6.0	18.71	123
72	41.1	3.2	1.9	4.9	12.03	130
84	55.0	3.1	1.5	6.6	11.95	169
77	27.8	4.0	1.4	4.3	15.31	112
78	50.6	2.2	3.5	7.2	14.29	110
70	33.6	3.5	1.9	4.4	13.17	116
70	31.1	3.5	1.7	4.1	13.21	110
70	37.5	3.1	2.0	4.7	12.31	114
65	34.6	4.3	2.9	5.8	16.64	148
63	42.4	2.8	3.4	7.5	17.66	120
60	29.8	4.7	1.1	4.3	14.39	140
54	37.3	3.6	2.3	4.2	15.28	133
72	43.5	3.5	2.2	6.5	14.95	152
60	67.6	2.1	2.6	9.0	13.32	144
93	25.5	4.7	1.5	3.7	14.68	121
65	39.2	3.8	1.6	3.2	8.27	148
50	41.2	3.2	3.3	6.5	15.90	131
			Mean Values			
67	40.7	3.3	2.3	5.7	14.23	129

See Table 1 for explanation of abbreviations.

low 4.9 cc. O_2/min./100 gm. brain in the control state.) There were no significant differences between the two groups in the changes observed as the result of CO_2 inhalation.

In tables 5 and 6 are recorded the results before and during the intravenous administration of 0.5 gms. aminophylline to 9 normotensive subjects and 8 hypertensive subjects. In each group there was a statistically significant decrease in mean cerebral blood flow, from control to experimental values. The degree of change from control to experimental values was statistically similar (not significantly different) in the two groups. The mean cerebral metabolic rate was unchanged despite the reduced oxygen delivery resulting from the reduced cerebral blood flow. The average mean arterial blood pressure was not significantly changed by intravenous aminophylline.

Two subjects developed clinical evidence of cerebral vascular insufficiency during aminophylline administration and another experienced a generalized convulsion shortly after its administration was terminated. These cases will be reported in detail elsewhere.

In tables 7 and 8 are presented the results of studies before and during hyperventilation in 8 normotensive and 7 hypertensive subjects. In each group the mean cerebral blood flow during hyperventilation was significantly reduced from that of the resting state while the cerebral vascular resistance increased. The cerebral metabolic rate and the average mean arterial blood pressure were essentially unchanged. There was no significant difference in the observed effects of hyperventilation in normotensive and hypertensive subjects.

DISCUSSION

There has been much discussion regarding the capacity of the cerebral vasculature to change its caliber independently of the systemic blood pressure; and although the existence of intrinsic tonus is now generally recognized, it is only recently that a method for its quantitative evalution has been made available. Nevertheless, because of the multiple factors which may affect the value for cerebral vascular resistance, it is often difficult to determine with certainty the significance of this mathematical expression. The value itself represents only the simultaneous observation of blood pressure head and cerebral blood flow. However, the latter factor is dependent not only upon the head of pressure but also upon the length and caliber of the vasculature and

TABLE 3. EFFECTS OF BREATHING 5 PER CENT CO_2 IN NORMOTENSIVE ELDERLY SUBJECTS

AGE	CBF		CVR		$CMRO_2$		CDO_2		AO_2		MBP	
	C*	E*	C	E	C	E	C	E	C	E	C	E
60	33.5	89.9	2.7	1.0	2.5	2.6	5.0	14.2	14.98	15.78	91	90
73	25.5	32.7	3.8	2.2	2.2	2.2	4.4	6.3	17.11	19.25	96	134
66	29.9	58.4	2.8	1.6	1.4	2.2	3.0	7.1	10.05	12.15	83	93
50	29.6	40.2	3.3	2.5	2.7	1.8	5.6	7.9	18.80	19.67	98	105
75	63.6	94.5	1.4	1.1	1.5	2.6	2.7	5.1	4.20	5.38	89	105
89	31.9	81.6	3.0	1.3	1.9	2.0	4.3	11.8	13.37	14.46	96	106
91	44.1	51.4	2.0	2.0	2.3	2.2	6.3	7.8	14.29	15.15	90	100
72	42.7	53.6	2.5	2.4	1.8	2.0	4.8	6.1	11.29	11.37	108	128
78	32.0	37.1	2.7	2.6	2.3	2.6	4.9	5.9	15.25	15.88	86	98
78	34.2	36.9	2.6	2 9	2.1	2.0	5.1	5.8	14.78	15.62	89	106
63	36.4	41.8	2.9	2.7	2.1	2.7	6.7	8.3	18.52	19.76	105	113
70	32.5	66.1	3.0	2.9	1.7	1.9	4.5	10.0	13.97	15.12	98	193
73	31.4	37.9	3.3	3.2	2.4	2.4	5.0	6.3	15.89	16.64	103	120
102	20.7	37.0	4.4	2.8	1.5	1.6	2.8	5.2	13.61	14.15	92	105
						Mean Values						
74	35.0	55.5**	2.9	2.2**	2.0	2.2	4.6	7.8	13.93	14.97	95	115

*C = control E = experiment

**Indicates statistically significant change.

See Table 1 for explanation of abbreviations.

the viscosity of the blood. With the exception of effective vascular length the other factors seem to be subject to alteration.

It may be stated categorically that when any two of these remaining three factors are shown to remain essentially constant, then any change in rate of flow must result from a change in the third factor; moreover if a change in one or two of these factors does not result in the anticipated change in flow, then an augmenting or opposing change in the third factor is again indicated.

In most of the experiments of this investigation, the basis for changes in blood flow was limited to changes in pressure head or vessel caliber. Whatever the effect of anemia (lowered blood viscosity) on the cerebral vascular resistance in the control state, it is permissible to assume that no appreciable changes in blood viscosity occurred in the brief time preceding the experimental observations. In view of the fact that a simple proportionality exists between rate of flow and pressure head, any change in the value for cerebral vascular resistance (which takes into account only these two factors) in acute experiments such as here performed must indicate changes in vascular caliber.

The results presented in tables 1 and 2 again demonstrate, as has been previously noted (3), the changes in cerebral hemodynamics associated with age and/or the development of cerebral arteriosclerosis. It is apparent in this study that these changes are not appreciably influenced by the presence of hypertension, with the possible exception of the increased value for cerebral vascular resistance. It may be inferred from the introductory remarks of this discussion that the elevated values for cerebral vascular resistance in normotensive arteriosclerotic subjects and the low cerebral blood flow in spite of elevated blood pressure in hypertensive elderly subjects imply a reduced caliber of the cerebral vessels.

It is difficult, particularly with co-existent arteriosclerosis and hypertension, to determine

TABLE 4. EFFECTS OF BREATHING 5 PER CENT CO_2 IN HYPERTENSIVE ELDERLY SUBJECTS.

Age	CBF		CVR		$CMRO_2$		CDO_2		AO_2		MBP	
	C*	E*	C	E	C	E	C	E	C	E	C	E
70	34.8	28.4	4.2	5.1	1.0	1.9	4.2	3.7	12.15	13.02	145	144
66	31.9	46.0	3.9	3.0	2.8	3.3	6.0	9.3	18.71	20.04	123	139
72	41.1	35.4	3.2	3.5	1.9	1.6	4.9	4.5	12.03	12.66	130	123
84	55.0	59.6	3.1	3.2	1.5	2.6	6.6	7.9	11.95	13.19	169	193
77	27.8	29.3	4.0	4.7	1.4	1.6	4.3	4.7	15.31	15.88	112	139
78	50.6	77.0	2.2	1.6	3.5	3.9	7.2	11.5	14.29	14.99	110	126
70	33.6	53.8	3.5	2.8	1.9	2.1	4.4	7.5	13.17	13.98	116	150
70	31.1	51.0	3.5	2.5	1.7	2.1	4.1	7.2	13.21	14.38	110	128
70	37.5	52.8	3.1	2.7	2.0	1.9	4.7	7.1	12.31	13.49	114	140
65	34.6	46.1	4.3	4.0	2.9	2.7	5.8	8.1	16.64	17.60	148	185
63	42.4	45.5	2.8	2.0	3.4	2.9	7.5	8.2	17.66	17.99	120	92
60	29.8	29.5	4.7	5.2	1.1	1.2	4.3	4.2	14.39	14.37	140	153
54	37.3	51.9	3.6	2.7	2.3	2.5	4.2	8.0	15.28	15.32	133	140
72	43.5	52.7	3.5	2.9	2.2	3.0	6.5	8.2	14.95	15.57	152	154
60	67.6	69.1	2.1	2.2	2.6	1.6	9.0	9.8	13.32	14.24	144	153
93	25.5	48.0	4.7	3.1	1.5	1.5	3.7	7.2	14.68	14.96	121	150
65	39.2	42.6	3.8	3.2	1.6	1.4	3.2	4.3	8.27	9.98	148	138
60	32.4	35.4	3.6	3.4	1.5	1.2	4.7	5.0	14.59	14.55	117	119
						Mean Values						
69	38.9	47.2**	3.6	3.2	2.1	2.2	5.3	7.0	14.13	14.84	132	143

* C = control. E = experiment.
** Indicates statistically significant change.
See Table 1 for explanation of abbreviations.

TABLE 5. EFFECTS OF AMINOPHYLLINE IN NORMOTENSIVE ELDERLY SUBJECTS.

Age	CBF		CVR		$CMRO_2$		CDO_2		AO_2		MBP	
	C*	E*	C	E	C	E	C	E	C	E	C	E
93	29.2	18.4	2.8	4.6	1.9	1.3	3.5	2.3	12.08	12.72	83	85
93	43.9	36.8	2.1	2.4	2.1	2.4	4.5	3.8	10.26	10.31	93	89
73	32.8	22.0	2.4	3.7	2.5	1.9	5.0	3.3	15.35	14.69	79	82
86	40.0	28.1	2.3	3.3	1.4	1.9	3.8	2.9	9.58	10.19	93	93
60	31.6	26.6	2.3	3.1	2.6	2.8	4.6	3.8	14.47	14.27	83	82
56	31.9	22.6	3.1	4.5	1.6	1.3	4.7	3.2	14.75	14.28	100	101
68	33.6	27.0	2.5	3.2	1.9	1.7	4.0	3.2	11.94	11.80	85	86
75	44.8	35.1	1.9	2.5	2.6	2.8	5.4	4.1	11.97	11.80	84	88
102	35.4	20.9	2.5	2.4	1.6	1.4	3.7	2.3	10.44	11.19	88	72
						Mean Values						
78	35.9	26.4**	2.4	3.3**	2.0	1.9	4.4	3.2	12.32	12.36	88	86

* C = control. E = experiment.
** Indicates statistically significant change.
See Table 1 for explanation of abbreviations.

TABLE 6. EFFECTS OF AMINOPHYLLINE IN HYPERTENSIVE ELDERLY SUBJECTS.

Age	CBF		CVR		$CMRO_2$		CDO_2		AO_2		MBP	
	C*	E*	C	E	C	E	C	E	C	E	C	E
79	33.2	22.9	3.7	4.7	2.3	2.1	5.0	3.4	14.98	14.83	123	108
69	42.9	29.1	2.7	3.8	2.5	2.4	6.0	4.1	14.05	14.02	115	112
67	38.4	24.6	3.3	4.6	2.8	2.3	5.7	3.6	14.72	14.59	125	114
58	33.2	27.5	3.3	4.0	1.6	2.0	4.2	3.7	12.71	13.56	110	110
60	43.3	30.1	3.8	5.8	2.5	2.6	6.3	4.4	14.57	14.76	165	175
75	51.8	28.9	2.3	3.3	2.8	2.3	8.1	4.4	15.72	15.15	120	95
67	35.3	30.9	3.3	3.6	3.2	3.0	5.4	4.7	15.38	15.34	118	110
65	39.5	31.2	3.1	3.6	2.1	2.6	5.0	3.8	12.67	12.27	123	113
					Mean Values							
68	39.7	28.2**	3.2	4.2**	2.5	2.4	5.7	4.0	14.35	14.32	125	117

* C = control. E = experiment.
** Indicates statistically significant change.
See Table 1 for explanation of abbreviations.

TABLE 7. EFFECTS OF VOLUNTARY HYPERVENTILATION IN NORMOTENSIVE ELDERLY SUBJECTS

AGE	CBF		CVR		$CMRO_2$		CDO_2		AO_2		MBP	
	C*	E*	C	E	C	E	C	E	C	E	C	E
82	38.3	29.3	2.8	3.8	2.6	2.3	5.0	3.9	12.98	13.19	107	110
73	30.4	20.6	3.4	4.4	2.1	2.0	4.8	3.4	15.83	16.37	107	90
62	50.7	40.2	1.8	2.7	2.6	2.5	6.1	5.1	11.99	12.71	89	107
64	63.8	39.2	1.5	2.4	3.0	3.1	10.1	6.5	15.84	16.56	94	95
72	90.6	66.4	0.8	1.1	3.3	2.8	5.0	3.6	5.55	5.37	74	75
82	48.2	36.1	1.9	2.4	1.5	1.4	3.5	2.7	7.18	7.59	85	87
57	52.0	38.3	1.5	2.0	2.8	2.9	6.4	4.9	12.26	12.69	78	77
51	57.4	44.1	1.4	1.7	2.8	3.3	7.3	5.8	12.69	13.18	83	75
					Mean Values							
68	53.9	39.3**	1.9	2.6**	2.6	2.5	6.0	4.5	11.57	12.21	90	90

*C = control E = experiment
**Indicates statistically significant change.
See Table 1 for explanation of abbreviations.

whether the reduction in effective vessel diameter is wholly organic or whether a functional element is also present. An approach to this problem would seem to lie in the evaluation of the reactivity of the cerebral vasculature to various procedures, although this might not yield the desired information where maximal response to local metabolic factors may already be present or where the vascular wall is insensitive to stimulation. Nevertheless, the capacity for cerebral vasodilation even in the presence of arteriosclerosis would be prima facie evidence that the increased vascular resistance is at least partially of tonic origin.

Studies by Kety and Schmidt (10) indicate that in normal young men the inhalation of

TABLE 8. EFFECTS OF VOLUNTARY HYPERVENTILATION IN HYPERTENSIVE ELDERLY SUBJECTS

AGE	CBF		CVR		$CMRO_2$		CDO_2		AO_2		MBP	
	C*	E*	C	E	C	E	C	E	C	E	C	E
62	40.1	27.0	3.6	5.1	3.2	3.3	6.7	4.6	16.80	17.94	143	135
62	46.8	35.4	2.7	3.3	3.3	3.2	7.2	5.6	15.28	15.84	125	118
73	58.2	32.2	2.1	3.4	3.6	2.6	8.3	4.6	14.21	14.34	125	111
81	39.0	34.6	3.2	3.2	2.2	3.0	4.8	4.4	12.31	12.60	124	109
81	48.0	39.0	2.4	2.8	3.8	3.4	5.9	4.8	12.27	12.31	115	109
51	50.0	33.6	2.4	3.7	2.7	2.9	7.2	5.1	14.43	15.10	121	125
50	41.2	37.1	3.2	3.3	3.3	3.2	6.5	5.9	15.90	16.04	131	123
60	29.6	23.6	4.8	5.1	0.6	1.2	4.7	3.7	15.95	15.75	143	120
53	46.3	30.4	2.7	3.3	1.9	1.7	5.8	3.9	12.60	12.79	123	100
					Mean Values							
61	44.6	32.1**	3.1	3.8**	2.6	2.6	6.4	4.8	14.47	14.77	128	116

*C = control E = experiment

**Indicates statistically significant change.

See Table 1 for explanation of abbreviations.

carbon dioxide causes an increase in cerebral blood flow, a decrease in cerebral vascular resistance, and an increase in blood pressure. In an unselected group of elderly patients similar but less marked changes were observed (3). The effects of 5 per cent CO_2 on cerebral hemodynamics of young hypertensive patients have not been investigated to our knowledge.

In the present study, which considers separately normotensive and hypertensive elderly subjects, an increase in cerebral blood flow and a decrease in cerebral vascular resistance were observed in both groups during the inhalation of 5 per cent CO_2. In the normotensive subjects, the change in mean cerebral blood flow was 59 per cent, and in mean cerebral vascular resistance, 24 per cent; in the hypertensive subjects the changes were 21 and 11 per cent. These changes do not represent any statistically significant differences between the responses of normotensive and hypertensive subjects with cerebral arteriosclerosis.

The presence of a significant response of the cerebral vessels in elderly hypertensive subjects demonstrates that even in this group the vasculature is capable of at least partial relaxation. These results indicate that the higher cerebral vascular resistance for the hypertensive group is to a considerable extent due to increased tonus, similar to the findings in younger hypertensive subjects (5, 6, 7). It seems probable that the response of our arteriosclerotic hypertensive subjects was less than that of Kety's (6) younger group but a statistical comparison is not feasible because of possible differences in technique.

Previous studies in normal subjects during the intravenous administration of aminophylline (17) or during hyperventilation (8) have disclosed a significant decrease in cerebral blood flow associated with a significant increase in cerebral vascular resistance. Our results demonstrate quantitatively similar changes in cerebral hemodynamics of elderly subjects with or without hypertension (there was no significant difference in the reaction of the two groups) in spite of the presence of cerebral arteriosclerosis. Specifically, the administration of aminophylline was accompanied by a 26 per cent decrease in cerebral blood flow and a 38 per cent increase in cerebral vascular resistance of the normotensive subjects, while the cerebral blood flow of hypertensive subjects decreased

29 per cent and their cerebral vascular resistance increased 31 per cent.

During hyperventilation in normotensive arteriosclerotic subjects, the cerebral blood flow decreased 27 per cent with an accompanying increase of 37 per cent in cerebral vascular resistance; in the hypertensive subjects who were hyperventilated, the cerebral blood flow decreased 28 per cent and the cerebral vascular resistance increased 23 per cent. These findings indicate that in both types of subjects the cerebral vessels were sufficiently elastic to undergo a further increase in tonus.

In a small number of our subjects we were unable to induce cerebral vasodilatation by administration of 5 per cent CO_2. In view of the infrequency of unresponsiveness to aminophylline and hyperventilation, a general rigidity of the cerebral arterial tree is apparently unusual and is not a likely explanation for the lack of response to CO_2. It seems more probable that in the latter instances maximal reduction of cerebral vascular tonus may already have been induced by local metabolic factors. Nevertheless, in the majority of cases the degree of cerebral arteriosclerosis may well be a limiting factor in determining the extent to which cerebral vessels can constrict or dilate.

Finally, it should be mentioned that the procedure used to estimate cerebral hemodynamics measures only total cerebral blood flow and gives no indication of what is happening to the individual cerebral vessels and their tributaries. Thus, where general reactivity of the cerebral vasculature may be demonstrated in an arteriosclerotic subject, it is not improbable that some vessels may be totally unresponsive, some only partially reactive, while others may respond to a normal degree.

Summary

Cerebral hemodynamics and oxygen consumption of persons 50 years of age or older having cerebral arteriosclerosis with or without hypertension were studied before and during inhalation of 5 per cent CO_2 or intravenous administration of aminophylline and during hyperventilation. The changes observed in cerebral blood flow, oxygen delivery, and cerebral vascular resistance were similar to but less marked than those previously noted for younger subjects with no evident cerebral vascular disease. Behavior of cerebral functions toward these several agents was essentially identical in both normotensive and hypertensive subjects. These findings indicate that even in the presence of cerebral arteriosclerosis with or without hypertension the cerebral vasculature is capable of at least partial relaxation and conversely is sufficiently elastic to undergo a further increase of tonus in response to appropriate stimuli.

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Obstructive Pulmonary Emphysema and Bronchial Obstruction by Lymphatic Tissue in Aging Rats

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OBSTRUCTIVE pulmonary emphysema is a condition in which the alveoli of the lungs become permanently distended or ruptured and arises from conditions which maintain greater interference with expiration than with inspiration. Permanent distention of alveoli may lead to local reduction of blood circulation, nutritional disturbances, and loss of elasticity.

Since inspiration is accomplished by positive muscular effort and expiration is ordinarily passive and less forceful, prolonged partial obstruction of bronchi produces emphysema by interfering more greatly with expiration than with inspiration. According to Kountz and Alexander (1), in their excellent monograph on emphysema, obstructive emphysema, as distinguished from "postural" emphysema, is by far the more important form in that it is responsible for the majority of symptoms encountered clinically. According to these authors, there is every indication that by far the largest number of cases of emphysema, with the exception of the postural type, follow bronchial obstruction, the most frequent underlying diseases being asthma and chronic bronchitis.

The close association of infectious bronchial disease with obstructive emphysema is based largely on anatomic descriptions of lungs in advanced disease states, so that earlier pathologic events in the etiology of obstructive emphysema remain obscure. It seems still uncertain whether pulmonary infections associated with emphysema are always causes or sometimes secondary complications.

In the pathologic investigation of lungs of many hundreds of rats of various ages, the author was impressed with the well-known fact that there is a great increase in the incidence of pneumonia and severe infectious bronchial lesions among rats in the second and third years of life. According to Ratcliffe (2), inflammatory and suppurative diseases of the lungs probably are the most common of all morbid conditions of adult rats.

In rats exhibiting pulmonary infection, the author has observed in the lung emphysematous regions and partially obstructive bronchial lesions, which could presumably be related causally, and also atelectatic regions presumably related to completely obstructed bronchi. However, in other rats which were sacrificed for histologic examination and in which there was no evidence of infectious pulmonary disease, emphysema was evident also. The only clue to the possible mode of bronchial obstruction in such cases was the presence, in one section of one case, of a partially obstructive nodule of hyperplastic peribronchial lymphatic tissue.

It became of interest to determine whether such discrete, localized obstructions of bronchial passages could be demonstrated consistently in noninfected emphysematous lungs, whether any of the obstructive tissues discovered could be considered infectious in origin in the usual sense, and whether there was any possibility that the high incidence of infectious pulmonary disease in rats might be secondary, in part at least, to the emphysematous condition.

This paper is a report of an histologic examination of rat lungs, made in an attempt to shed some light on these problems.

MATERIALS AND METHODS

In this laboratory over the past several years, autopsies have been performed on hundreds of experimentally untreated albino rats of vari-

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ous ages after sacrifice or spontaneous death. Many of these autopsies were extensive, and complete descriptions of all organs, including the lungs, were recorded. Lung samples were included among the routine organ samples preserved in fixative and embedded in paraffin blocks for histologic sectioning. After routine sectioning, the tissue blocks were stored.

The records of gross and microscopic observations on 163 sacrificed control (untreated) male rats were examined. There were 21 rats from 24 to 28 months of age, all of which exhibited infectious pulmonary lesions of various grades, in many cases associated with emphysema. There were 94 rats from 5 to 18 months of age, none of which revealed definite emphysema. There were 48 rats from 18 to 24 months of age. Of 29 of these rats, 14 revealed emphysema associated with infectious lesions and 15 exhibited no emphysema although many of them had pulmonary lesions to some degree. In the remaining 19 rats in the 18 to 24 month age group there was definite gross and histologic evidence of pulmonary emphysema without any evidence of infectious pulmonary disease. These 19 rats are the subject of this paper. The rats were of the Wistar strain.

The lung samples, which had been fixed in Bouin's fluid and embedded in paraffin, were sectioned at intervals of 300 μ, yielding about 7 or 8 sections per rat. The sections were cut approximately 7 μ thick.

These rats had been maintained in the same colony under similar conditions and were fed Purina Laboratory Chow (with meat meal) and water *ad libitum*.

Results

Recorded Gross Observations

In each of the 19 cases the lungs were pale and grossly distended and did not collapse as the normal lung does when the chest wall was opened. Localized pressure on these lungs caused pitting.

Microscopic Observations

Parenchyma of Lung.—Many of the alveoli were excessively distended to various degrees, the alveolar walls often being stretched very thin and sometimes ruptured, forming relatively large cavities into which the threadlike remnants of alveolar septa protruded. There were no other lesions of the parenchyma.

Bronchi.—The additional sections made revealed no appreciable evidence of infectious disease of the bronchi. However, in one or two sections in each of 14 of the 19 cases there was revealed partial obstruction of a bronchus of relatively large size by means of a nodule of hyperplastic peribronchial lymphatic tissue which projected into the lumen. Figure 1 presents a typical obstructive nodule in a bronchus. The nodules tended to become polypoid, i.e., pedunculated. In general, the bronchial epithelium, including the portions covering the invaginating nodules, seemed completely normal, although in sectioning the epithelial layer was sometimes torn loose from parts of the nodules.

The cellular constituents of the nodules were those of normal lymphatic tissue, and there was no evidence of an inflammatory condition in the usual sense.

Discussion

The finding of bronchial obstruction by invaginating polypoid nodules of hyperplastic peribronchial lymphatic tissue in the emphysematous lungs of 14 of the 19 rats in which there was no histologic evidence of other pulmonary disease seems to indicate clearly a causal relation of this obstruction to the emphysematous condition. It seems probable that such obstruction would have been discovered in some of the other 5 rats also, had there been available more lung tissue, especially that toward the base of the lungs.

Since the cellular composition of the obstructing nodules is that of normal noninflammatory lymphatic tissue, and since the bronchial epithelium, including that covering the nodules, exhibits no evidence of inflammation, the nodules can only be classified as hyperplastic lymphatic nodules.

The data suggest the possibility that obstructive emphysema of this type developing in rats

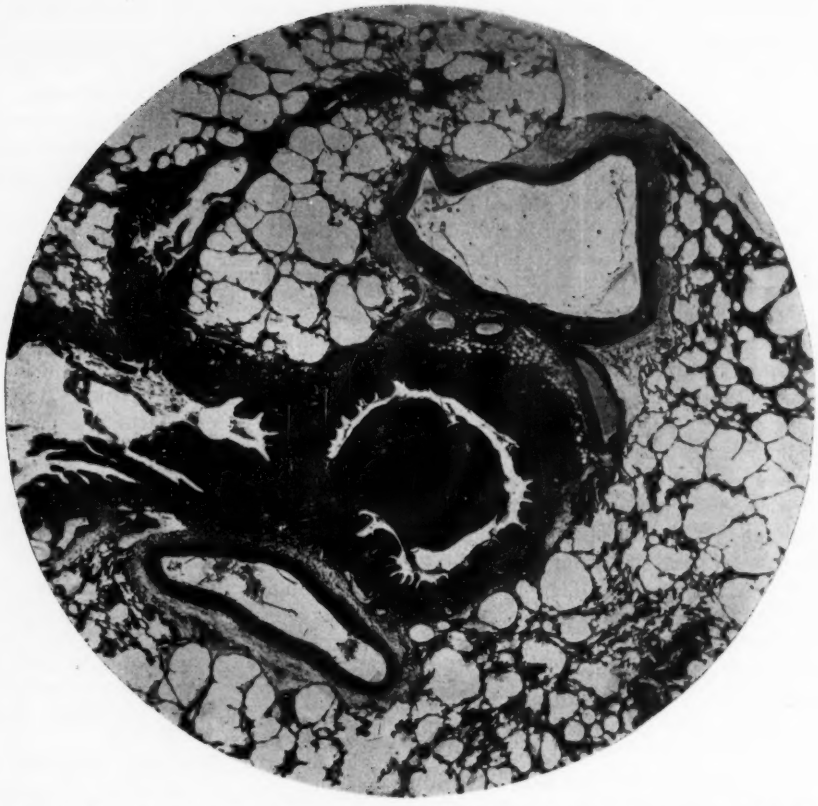

FIG. 1. Nodule of hyperplastic peribronchial lymphatic tissue projecting into lumen of a bronchus.

during the period from 18 to 24 months of age may predispose the rats to pulmonary infections and may be responsible, in part at least, for the steadily increasing incidence of extensive pulmonary infection during this period and later. It would seem that the emphysema observed in the infected lungs of aging rats is not entirely the result of the associated infectious lesions.

SUMMARY

In a group of 163 sacrificed untreated male albino rats of various ages and of the Wistar strain, gross and histopathologic examination revealed that none of the 94 rats from 5 to 18 months of age exhibited definite pulmonary emphysema and that all of the 21 rats from 24 to 28 months of age exhibited infectious pulmonary lesions of various grades, often associated with emphysema. Of the 48 rats from 18 to 24 months of age, 14 revealed emphysema associated with pulmonary infections and 15 showed no emphysema with or without associated pulmonary infections. The remaining 19 rats in this age group exhibited definite pulmonary emphysema without evidence of pulmonary infection. Histologic sections made at intervals of 300 μ in the preserved and embedded lung samples from these 19 rats disclosed in one or two sections from each of a total of 14 of the 19 rats the partial obstruction of relatively large bronchial branches by invaginating nodules of hyperplastic lymphatic tissue. It is probable that such obstruction

could have been found in some of the other 5 cases had more embedded lung tissue been available.

The data indicate that the lymphatic hyperplasia observed is a cause of pulmonary emphysema in aging rats and suggest that the greatly increasing incidence of severe pulmonary infection in aging rats may well be related to the predisposing condition of this obstructive pulmonary emphysema.

This paper is based on work performed under contract with the United States Atomic Energy Commission at the University of Rochester Atomic Energy Project, Rochester, New York.

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The Presence of Carbonic Anhydrase in the Media of the Human Aorta[1]

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INVESTIGATIONS pertaining to the metabolism of arterial tissue are as yet rather scarce. Since it may be assumed that information regarding the enzyme systems present in the arterial wall may contribute to the understanding of the normal and pathologic metabolism of the arterial wall such studies have in the last few years been in progress in our laboratory. The present communication deals with the demonstration of carbonic anhydrase in the media of the human aorta.

METHODS

Samples of human aortas were obtained fresh at autopsy and wiped carefully free from blood. The intimal and adventitial coats were stripped off and the media ground with saline in a pyrex grinder, 9 ml. of saline being employed for each gram of tissue. The homogenate was centrifuged at 3000 r.p.m. for fifteen minutes and the supernatant solution used for studies on carbonic anhydrase activity. In all instances samples of blood were obtained at autopsy from the same individuals, and preparations of laked blood corpuscles in various dilutions with distilled water simultaneously assayed for carbonic anhydrase activity. The inclusion of assays of corresponding blood samples in the experiments made it possible to express the carbonic anhydrase activity found in the aortic tissue in relation to the activity of the red blood cells and to make adequate corrections for the small amounts of blood contained in the tissue homogenates.

Since the luminal two-thirds of the human aortic media usually contains no blood capillaries (9) the blood content of homogenates prepared from the media is minimal. Such homogenates will usually appear milk- or cream-colored (2) and analyses of the homogenates for hemoglobin by the gasometric method of Van Slyke and Neill (8) give zero readings. For quantitative evaluation of the small blood content of homogenates of the aortic media a sensitive benzidine method, capable of estimating blood in dilutions up to 1:50,000, was developed.

Determination of blood content of tissue homogenates. Twenty cu. mm. of the homogenate were placed on the surface of a block of solid paraffin by means of a micro pipette. Ten cu. mm. of a freshly prepared, unheated, saturated solution of benzidine hydrochloride "Merck" in glacial acetic acid, and 10 cu. mm. of a 3 per cent hydrogen peroxide solution were then deposited next to the homogenate drop. The benzidine and hydrogen peroxide drops were mixed with a small glass rod provided with a ball point, and the combined drops subsequently stirred with the homogenate drop. In the presence of hemoglobin a green color develops, which later turns into a brownish color. Both the green and brown colors were compared with the colors of similarly treated 20 cu. mm. samples of laked red blood cell preparations in various dilutions. In the application of the procedure to aortic tissue homogenates blood cell dilutions containing 0.1, 0.5, 0.02, 0.01, 0.005, and 0.002 weight per cent of red blood corpuscles were used for comparison. Separate glass rods were employed for each of the blood standards. A 20 cu. mm. drop of distilled water served as a control. The reliability of the benzidine method was checked by adding known amounts of blood to varying amounts of homogenate; a quantitative recovery of the added blood was obtained.

For determination of the carbonic anhydrase activity of the homogenates and diluted blood samples two procedures were used, one based on the catalysis by the enzyme of the hydration of carbon dioxide and the other on the catalysis of the dehydration of carbonic acid. Of these two methods the hydration procedure lends itself more easily to quantitative calculation of the enzyme activity.

The determination of the hydration velocity of carbon dioxide was made by a modification of the colorimetric method of Trethewie and Day (6). Since the modifications introduced were found to increase the accuracy of the procedure a description of the modified technique will be given here.

MODIFIED PROCEDURE OF TRETHEWIE AND DAY

Reagents:

0.02 M Barbital — 0.02 M. Sodium barbital buffer. The reagent was prepared by dissolving 3.684 Gm. of barbital and 4.124 Gm. of sodium barbital in 1 L. of

[1] Studies on Arterial Metabolism II.

distilled water. The pH of the prepared solution was 7.92.

Brom thymol blue solution, 0.02 per cent. The solution was prepared as described by Peters and Van Slyke (4) by the addition of 16.0 ml. of 0.01 N Sodium hydroxide solution for each 0.1 Gm. of the indicator and subsequent dilution with distilled water. The pH of the indicator was adjusted to 7.92.

Combined Barbital — Sodium barbital — Brom thymol blue reagent. Prepared immediately before use by adding 1 volume of brom thymol blue solution to 29 volumes of the barbital-sodium barbital buffer.

Carbon dioxide saturated distilled water. This was prepared by bubbling carbon dioxide from a cylinder through distilled water contained in a silver lined Dewar vessel. The carbon dioxide was admitted through a dispersion tube. To the water was added crushed ice, manufactured from distilled water in the freezing unit of a refrigerator.

Comparator solution. Prepared by adding 0.33 ml. of brom thymol blue solution to 9.67 ml. of phosphate buffer of pH 6.3. The solution was kept in a 10 ml. stoppered volumetric flask.

Apparatus:

Short necked 10 ml. volumetric flasks with ground stoppers.

Glass syringe, 5 ml. capacity, provided with a long, thick, paraffin coated needle.

Two silver lined cylindrical Dewar vessels, inside diameter 70 mm., outside diameter 95 mm., capacity 2000 ml.

Preparation of buffer-enzyme samples. One ml. of distilled water was pipetted into a 10 ml. volumetric flask, and 1 ml. of supernatant, supernatant dilution, or blood cell dilution added, followed by 3 ml. of the buffer indicator solution. The flasks were stoppered with the glass stopper, labelled, and submersed for at least fifteen minutes in water with crushed ice (temperature 0.5 C.) contained in a basin. The empty 5 ml. glass syringe with attached needle was likewise placed in the ice water.

Determination of reaction time. The comparator flask was placed in a Dewar vessel, filled with water and crushed ice. The enzyme-containing volumetric flasks were then removed one by one from the basin and immersed in the ice water of the Dewar vessel next to the comparator flask. Five ml. of carbon dioxide saturated ice water were drawn into the glass syringe and any gas bubbles present quickly ejected. The glass stopper of the test flask was removed and the needle of the syringe inserted into the flask until the tip touched the bottom. The content of the syringe was then emptied into the volumetric flask in the course of one second, and the stop watch started. The glass stopper was reinserted into the volumetric flask and the syringe returned to the basin with ice water.

By occasionally removing the flask from the ice water in the Dewar vessel and viewing it against a diffuse light the time was recorded for the sample to attain the yellow color of the comparator flask.

Blank determinations were carried out by replacing the 1 ml. of supernatant or blood cell dilution with 1 ml. of distilled water. Under the conditions of the experiment the reaction time for the uncatalyzed reaction was 78 to 86 seconds.

For examination of the inhibiting effect of sulphanilamide on the reaction 1 ml. of a 0.05 per cent solution was added to the flask instead of the 1 ml. of distilled water, giving a sulphanilamide concentration of approximately 0.3 mM in the final 10 ml. volume.

Calculation of enzyme activity. For each homogenate sample, reaction times were determined on homogenates of different concentrations (usually 10, 5, and 2 per cent homogenate preparations of the tissue) and the reaction curve resulting from these determinations constructed. In connection with the assay of the homogenate the reaction times of preparations of laked blood cells from the same individual were determined. As previously mentioned the blood cell preparations used contained 0.1, 0.05, 0.02, 0.01, 0.005, and 0.002 weight per cent of red blood corpuscles. From the reaction curves of the homogenate and red blood cell preparations the weight equivalent of red blood cells corresponding to each homogenate dilution employed was obtained. The two levels of homogenate concentration which gave reaction times between 25 and 55 seconds were chosen for calculation of the carbonic anhydrase activity of the tissue, a correction being made for the blood content of the sample, as determined by the benzidine method.

The dehydration velocity of carbonic acid was measured manometrically by a modification of the procedure of Brinkman, Margaria, and Roughton (1), using reagents of the composition described by Leiner (3). The modified manometric method employed by the authors possesses the advantages of using standard equipment (Summerson manometers, Warburg water bath) available in many laboratories and of providing facilities for reading the pressure changes on manometers placed firmly on a rack not attached to the shaking device of the apparatus. Although the measurements obtained with this technique in the present study have not been used for quantitative calculation of the carbonic anhydrase activity of the samples, the inclusion of demonstrations of the catalyzing action on the dehydration of carbonic acid effected by homogenates of the media of the aorta would seem of importance, since the catalysis of this reaction probably

represents the main function of the enzyme in the arterial tissue (see Discussion). Because of the technical improvements introduced by the authors a description of the modified manometric method will be given here.

Modified Procedure of Brinkman, Margaria and Roughton

Reagents:

0.02 M Na_2HPO_4 — 0.02 M KH_2PO_4 buffer. The reagent was prepared by dissolving 2.58 Gm. of Na_2HPO_4 and 2.72 Gm. of KH_2PO_4 in 1 L. of distilled water.

0.02 M Sodium bicarbonate — 0.002 M Sodium hydroxide solution. The reagent was prepared by dissolving 1.68 Gm. of sodium bicarbonate and 0.08 Gm. of sodium hydroxide in 1 L. of distilled water. The solution was distributed in small bottles, closed with paraffin sealed stoppers.

Apparatus:

Reaction flasks of about 30 ml. capacity, boat shaped, constructed from ordinary tissue metabolism flasks without center well supplied with the Summerson manometers. Each flask is divided into two compartments by means of a low ridge in the bottom. Two flasks were used in each experiment, one for registering the reaction and the other as a thermo control.

Three Summerson (5) differential manometers.

One constant temperature Warburg bath with shaking device attached to a motor, permitting 325 double movements of the flasks per minute.

One rack for holding registering manometers.

Assembling of apparatus. An illustration of the assembled apparatus is given in figure 1. As seen from the figure the ground openings of the flasks are attached to the glass cones of one Summerson manometer. The manometer is secured firmly to the shaking device on the outside of the Warburg bath. The four branches of the manometer are labelled 1, 2, 3, and 4. The stopcock A, connecting 2 and 3, is kept constantly closed (in an oblique position). Branches 2 and 3 are completely filled with Brodie's fluid, branches 1 and 4 only to the place of junction with the connection tube from the flask.

For registration of pressure changes in the flasks the upper, free ends of manometer branches 1 and 4 are each connected by means of heavy rubber tubing with a complete Summerson manometer. These two Summerson manometers are placed in a standard Warburg rack placed at a suitable distance in front of the water bath. Since they are not shaken during the experiment, pressure readings can be made without difficulty. The branches of these manometers are labelled 5, 6, 7, 8, 9, 10, 11, and 12. The lateral branches of the manometers (5, 6, 11, and 12) are free from fluid and serve to establish atmospheric pressure in the flasks and in the registering manometer branches (7 and 10) by turning of the stopcocks B and C. The manometer branches 7, 8, 9, and 10 are partially filled with Brodie's fluid for registration of pressure changes in the flasks.

Measurement of carbonic acid dehydration velocity. Two ml. of the sodium bicarbonate-sodium hydroxide reagent were placed in one of the compartments of the reaction flask and 2 ml. of phosphate buffer in the other compartment. One ml. of homogenate or of laked blood cell dilution was added to the side containing the phosphate buffer. The thermo control flask contained 5 ml. of distilled water.

The ground openings of the flasks were greased with anhydrous lanolin and the flasks carefully lowered into the water bath, maintained at exactly 15 C. The careful handling of the reaction flask is necessary to avoid mixing of the contents of the two compartments.

In attaching the reaction flask to the ground glass cone of the Summerson manometer care was taken to insure that the glass ridge at the bottom of the flask was placed at 90° angle to the shaking direction. After application of the metal springs the flasks were left for ten minutes without shaking for establishment of temperature equilibrium.

At the end of the ten minute period stopcocks B and C were turned (cocks in horizontal position) so as to connect the flasks and the registering manometer branches 7 and 10 with the atmospheric air, and Brodie's fluid in 7 and 10 adjusted to the 20 mark on the manometer scales. Cocks B and C were then turned (cocks in vertical position) so as to establish connection between branches 7 and 10 and the flasks, and the shaking of the flasks was started. The shaking was performed at a rate of 325 double movements per minute with a stroke distance of 1.5 cm. Readings of the pressure changes were made at ten second intervals for a period of three minutes.

Determinations of the uncatalyzed reaction (blank determinations) were carried out by replacing the homogenate in the reaction flask with 1 ml. of distilled water. For examination of the inhibitory effect of sulphanilamide, 2 ml. of phosphate buffer having a sulphanilamide concentration of 0.0125 per cent were used instead of the ordinary phosphate buffer; this resulted in a final concentration of the drug in the mixed flask contents of approximately 0.3 mM.

Test for air tightness. Before onset of the experiments the tightness of the apparatus was checked in the following way: Cocks B and C were turned to the horizontal position, establishing connection between the atmospheric air, the registering manometer branches, and flasks. The Brodie fluid in branches 7, 8, 9, and 10 was then forced upwards by exerting pressure on the rubber tubing at the bottom of the manometers. While the pressure was maintained the cocks were turned to the vertical position. By now

releasing the pressure on the rubber tubing a negative pressure in the flasks was created. This pressure was recorded and was checked after several minutes. In the absence of leaks the pressure would remain unchanged.

Conversion of observed pressure changes into volumetric units. For construction of curves representing the amount of carbon dioxide evolved during the dehydration of carbonic acid the recorded pressure changes were converted into cubic millimeters of gas. The conversion factors may be determined by introducing known amounts of gas into the closed system and recording the pressure changes on the manometers.

A more convenient, but slightly less accurate way of establishing the conversion factors is to lower Brodie's fluid in branches 1 and 4 and observe the resulting pressure changes on the registering manometers 7 and 10. The volume changes produced in 1 and 4 can be accurately determined by filling the sections of the tubes with mercury and weighing.

Example: The Brodie fluid in branch 1 was lowered 200 mm. from mark 20 to mark 0. This resulted in an excursion on branch 7 of 30 mm. Since the volume between the 20 and 0 marks was found by calibration with mercury to equal 315 cu. mm., each millimeter on branch 7 represents a gas development of $315/30 = 10.5$ cu. mm.

Results

The blood content of the medial tissue of 12 human aortas, as determined by the benzidine method, was found to range between 0.01 and 0.35 per cent (mean 0.12 per cent) of the weight of the tissue (table 1). In the same table the results of quantitative assays performed with the hydration method of the carbonic anhydrase activity of the same 12 aortic samples (16 homogenates) are presented. It will be seen from the table that the carbonic anhydrase activity of the tissue ranged between 0.14 and 0.99 per cent of that of an equivalent weight of red blood cells and that the mean value found was 0.40 per cent. Assuming an average red blood cell volume of about 40 per

Table 1. The Carbonic Anhydrase Activity of the Media of the Human Aorta, Determined by a Modification of the Procedure of Trethewie and Day.

Number	Sex	Age in Years	Red Blood Cell Content of Aortic Tissue	Carbonic Anhydrase Activity of Media of Human Aorta, Expressed in Percentage of Activity of Red Blood Cells			
			Per cent	I[1]	II[2]	III[3]	Average
1 a.	M	57	0.10	0.58		0.43	0.51
b.	M	57	0.07	0.58		0.41	0.50
2 a.	M	73	0.15	0.56		0.48	0.52
b.	M	73	0.35	0.55		0.53	0.54
3 a.	F	70	0.05	0.32	0.18		0.25
b.	F	70	0.03	0.21	0.14		0.18
4 a.	F	66	0.01	0.24	0.20		0.22
b.	F	66	0.03	0.19	0.21		0.20
5	M	57	0.20		0.48	0.50	0.49
6	F	72	0.10	0.34	0.33		0.34
7	M	67	0.12	0.25	0.36		0.31
8	M	60	0.09	0.29	0.34		0.32
9	F	9	0.08	0.12	0.16		0.14
10	F	70	0.20	0.33	0.30		0.32
11	M	58	0.15	0.40	0.36		0.38
12	M	64	0.20	1.05	0.93		0.99
Mean			0.12				0.40

[1] Analysis performed on 1 ml. 10 per cent homogenate.
[2] Analysis performed on 1 ml. 5 per cent homogenate.
[3] Analysis performed on 1 ml. 2 per cent homogenate.

cent, the mean carbonic anhydrase activity of the media of the human aorta corresponds to approximately 1 per cent of the activity of the enzyme in whole blood. The table further shows that a good agreement was usually observed between activity values calculated on the basis of the reaction times of various dilutions of the same homogenate and between values found in analyses of different homogenates prepared from the same aortic sample.

A survey of the reaction times noted for the various homogenate samples included in table 1 is given in figure 2. In this figure for each sample the reaction times of the undiluted (10 per cent) homogenate preparation and of the blank are presented. In addition the reaction time of a sample of laked blood cells from the same individual, equivalent to the blood content observed in the homogenate, is recorded. It will be noted that the carbonic anhydrase activity of the homogenates in all instances was found to be definitely greater than of the blood contained in the samples.

Representative observations on the dehydration velocity of carbonic acid effected by homogenates of the media of the human aorta are shown in figure 3. In agreement with the findings obtained with the hydration procedure the measurements of the dehydration velocity with the manometric method consistently revealed a definitely higher enzyme activity of the tissue homogenates than of samples of laked red blood cells in concentrations corresponding to the blood content of the homogenates.

Both the hydration of carbon dioxide and the dehydration of carbonic acid were markedly inhibited by sulphanilamide in 0.3 mM concentration.

Discussion

The demonstration, reported in this study, of a measurable carbonic anhydrase activity in the media of the human aorta raises the question of the probable function of this enzyme in the arterial wall. The carbonic anhydrase activity observed, equal to about 1 per cent of that of whole blood, must be characterized as low when compared with the enzyme concentration found in the gastric mucosa, parotid gland, pancreas, and kidney, for which organs activities corresponding respectively to 500, 80, 50, and 20 per cent of the activity of whole blood have been reported (7).

It is generally assumed that the high carbonic anhydrase activity of the latter tissues is related to the special secretory function of these organs, through which processes acid or alkaline secretions are produced. The function of carbonic anhydrase in a tissue which does not possess any secretory function requires another interpretation.

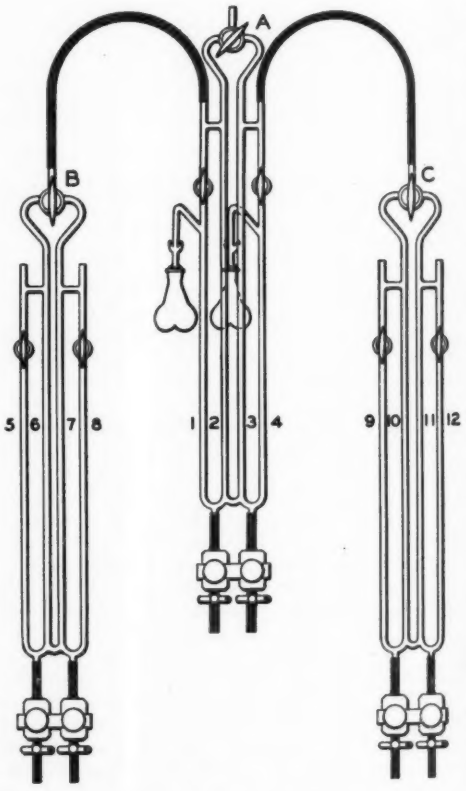

Fig. 1. Schematic illustration of apparatus used for manometric determination of catalysis of dehydration of carbonic acid by carbonic anhydrase. For explanation see text.

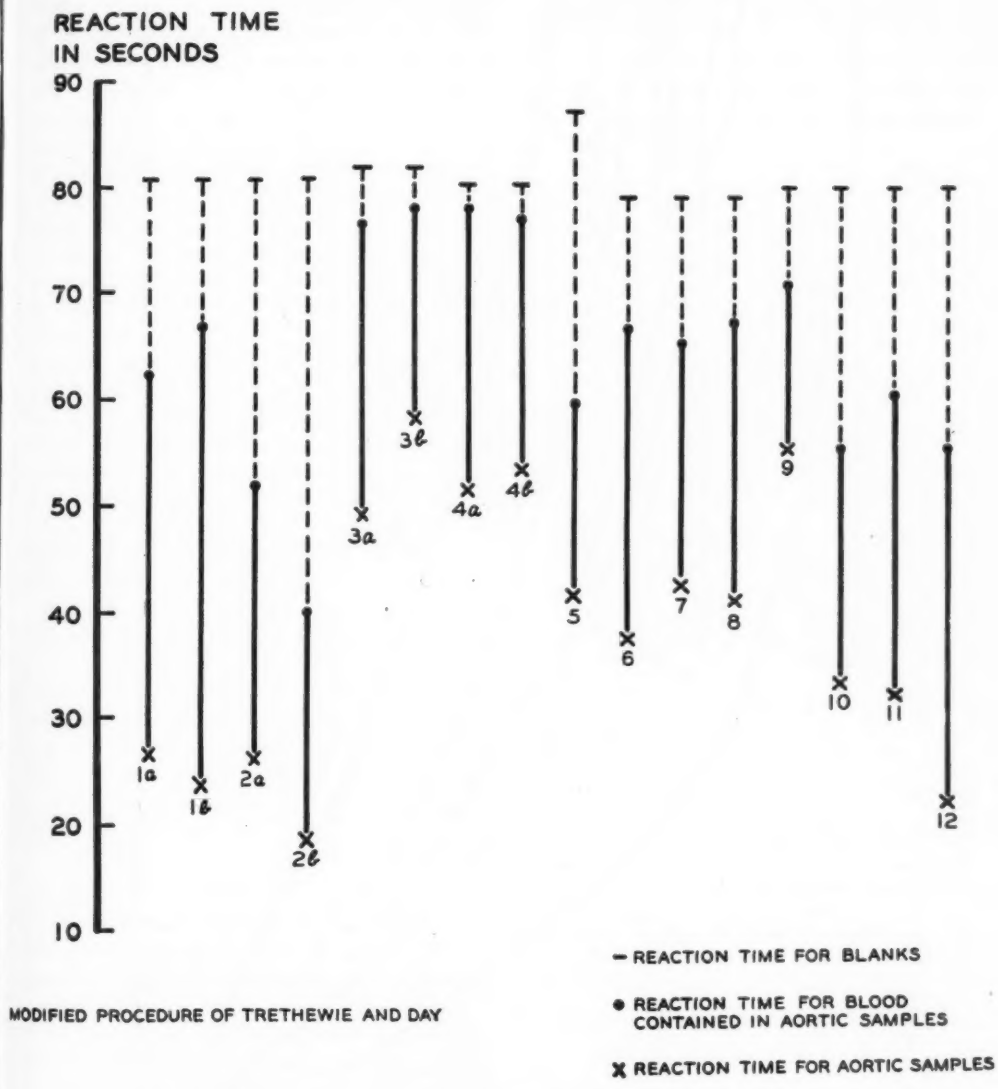

FIG. 2. Determination of carbonic anhydrase activity of homogenates of human aortas according to modified procedure of Trethewie and Day.

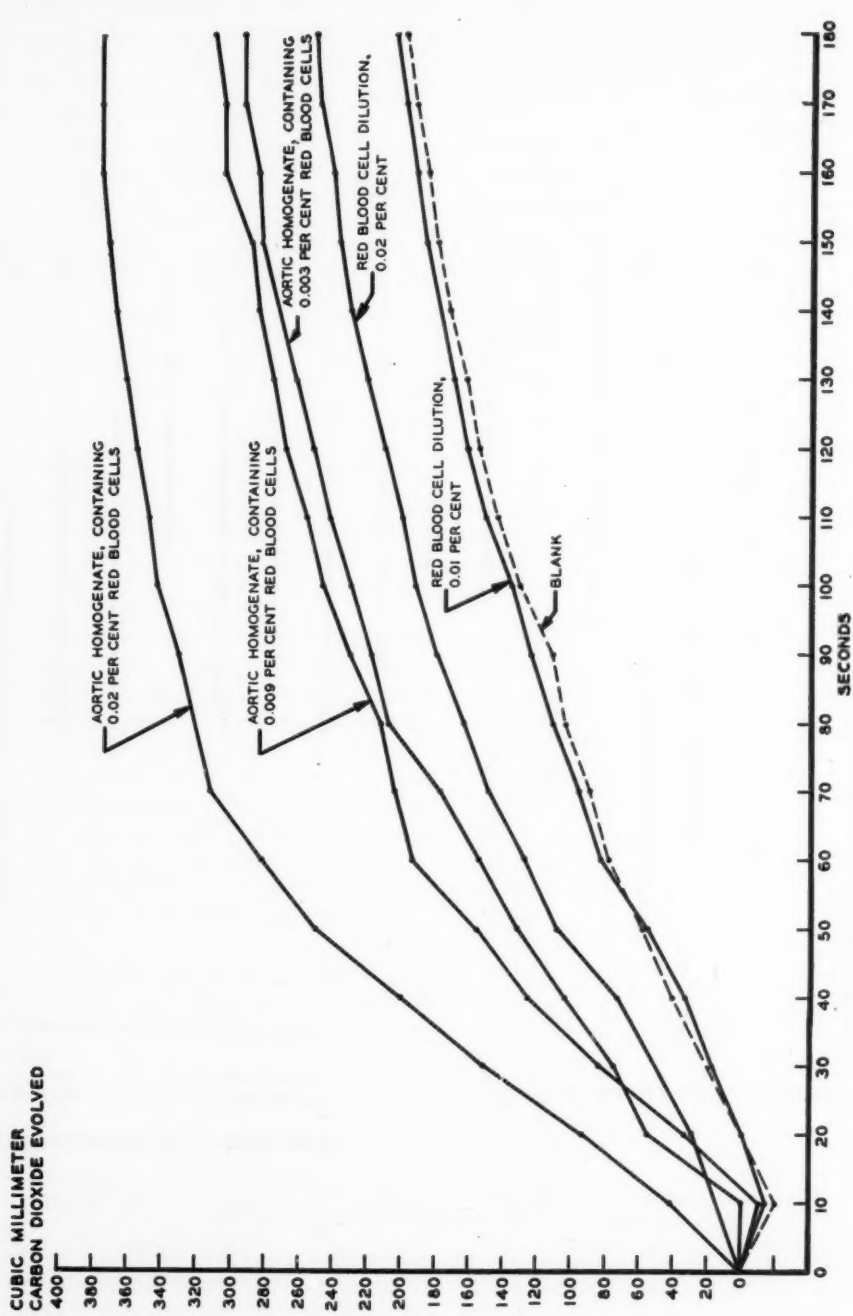

FIG. 3. Determination of carbonic anhydrase activity of homogenates of human aortas according to modified method of Brinkman, Margaria, and Roughton.

For explanation of the possible significance and mechanism of action of the enzyme in the wall of the human aorta a knowledge of the metabolic pattern of this tissue is necessary. It has been shown through studies in our laboratory conducted over the last few years that the metabolism of the human aortic wall is characterized by a relatively high rate of aerobic glycolysis, the glycolysis in *in vitro* experiments accounting for about one-half of the total energy production by the tissue. On the background of this knowledge it might be speculated that the function of carbonic anhydrase in the arterial wall consists in a catalysis of the dehydration of carbonic acid to carbon dioxide and water. As a consequence of the comparatively high rate of aerobic glycolysis rather large amounts of lactic acid are formed in the media of the aorta. The lactic acid produced will presumably in the tissue become neutralized by bicarbonate with a resulting formation of carbonic acid. In the presence of carbonic anhydrase the carbonic acid will be rapidly dehydrated to carbon dioxide and water. Since the diffusion rate of carbon dioxide is greater than that of carbonic acid a catalysis of the conversion of carbonic acid to carbon dioxide may be assumed to constitute a useful mechanism for the removal of this metabolite from the arterial wall. This suggested function of carbonic anhydrase in the media of the human aorta is similar to that proposed by van Goor (7) for the enzyme in the animal lens.

Summary

Determinations of the carbonic anhydrase activity of homogenates of the medial coat of human aortas, performed with a modification of the hydration procedure of Trethewie and Day, revealed an enzyme activity of the tissue ranging between 0.14 and 0.99 per cent of that of a corresponding weight of red blood cells. The mean activity found was 0.40 per cent, equal to approximately 1 per cent of the activity of whole blood. The presence of carbonic anhydrase in the aortic wall was confirmed by a modification of the manometric dehydration procedure of Brinkman, Margaria, and Roughton. The enzyme was markedly inhibited by sulphanilamide in 0.3 mM concentration.

The significance of the presence of carbonic anhydrase in the human aortic wall is discussed, and it is suggested that the function of the enzyme consists in a catalysis of the dehydration of carbonic acid to the more easily diffusible carbon dioxide.

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method of Brinkman, Margaria, and Roughton.

Pathogenesis and Significance of Hemoceroid and Hyaloceroid, Two Types of Ceroidlike Pigment Found in Human Atheromatous Lesions

W. STANLEY HARTROFT

CEROID is the name originally given by Lillie and associates (12) to the orange-brown pigment found, usually in abundant amounts, in the trabeculae of cirrhotic livers of rats which have been fed a diet low in choline. Because this pigment is not dissolved by alcohol, xylol, and other fat-solvents, it remains in paraffin sections where it exhibits intense sudanophilia. In a later publication, Endicott and Lillie (5) elucidated a number of its staining reactions, of which the most notable perhaps is its property of acid-fastness. Popper and associates (14) found that ceroid is strongly autofluorescent, emitting a greenish-yellow light when exposed to long ultraviolet rays.

In the study of the pathogenesis of dietary cirrhosis in choline-deficient rats in this laboratory, evidence accumulated suggesting that much of the ceroid formed in the fibrous trabeculae may have resulted from the intimate mixing of red blood cells in ruptured fatty cysts (6, 8). Microscopic observations have suggested that the fat which then coated the surfaces of red cells may have undergone autoxidation and condensation into alcohol-insoluble products which retained the characteristics of sudanophilia and fluorescence of the original hepatic lipid. Fat which has been deposited on tissues other than red cells seemed to undergo a similar alteration, but the resulting pigment was neither as abundant nor as strongly sudanophilic and fluorescent as that type of ceroid which appeared to have been derived from red cells coated with fat. These conclusions were supported by *in vitro* experiments (7) in which red cells and unsaturated fat were mixed and incubated (37 C.) together in test tubes, because after several days clumps of altered erythrocytes recovered from the incubation mixture were found to give the characteristic solubility tests and histochemical reactions for ceroid. These experiments were later extended by Casselman (4), who tested combinations of a large variety of lipids and tissues by the test tube incubation procedure. He found that the more unsaturated the lipid and the greater the oxidizing ability of the tissue, the greater the ceroid production. In accordance with these results, red blood cells may be regarded as the tissue *par excellence* for the conversion of unsaturated fats into insoluble ceroid.

In vivo experiments conducted by the author (7) also showed that when hemorrhages were produced in the mesenteric adipose tissue of male rats, ceroidlike pigment could be demonstrated at the sites of trauma when the animals were sacrificed three weeks later. This led to the hypothesis that abundant pigment resembling ceroid might be formed anywhere in the body at sites of intimate mixtures of unsaturated fats and red blood cells and that smaller deposits of less sudanophilic pigment might result when abnormal accumulations of unsaturated lipids involved tissues other than red cells.

As small hemorrhages or surface accumulations of erythrocytes in or around lipid deposits in atheromatous arteries of human subjects constitute clinical duplications of the experimental conditions described above, it occurred to us that ceroidlike deposits should abound in these lesions. A number of arteries obtained from patients coming to autopsy at the Toronto General Hospital were accordingly examined. The results, which were strikingly positive in nearly every instance, were in accord with those reported by Burt (3) in a paper which appeared while an abstract of the results of the author's investigations was in press (9).

The only other reference in the literature to the presence of acid-fast and sudanophilic pigment in paraffin sections of human atheromatous lesions is a brief note concerning its appearance in a small number of cases in which all organs and tissues had been surveyed by Pappenheimer and Victor (13).

In addition to affording independent confirmation of Burt's findings, the present paper reports evidence which suggests the differentiation, on morphologic and pathogenic grounds, of ceroidlike pigment in atheromatous lesions—*hemoceroid* and *hyaloceroid*—and gives the results of some experimental observations on the fibrosing character of hemoceroid. The latter work was carried out with the surgical assistance of Dr. A. M. Rappaport.

Materials and Methods

Human tissues. Paraffin sections were prepared from 25 aortas showing advanced stages of typical atheromatous change and from 10 additional vessels in early stages of the disease in which gross intimal thickening was barely apparent. Sections were also cut from 23 coronary arteries in which atheromatous narrowing had occurred and from a smaller series of miscellaneous atheromatous vessels (5 renal, 4 iliac, 4 femoral, and 9 cerebral arteries). Thrombi, unassociated with atheroma, in pulmonic arteries and in a number of veins (2 portal, 1 splenic, 1 jugular, 3 iliac) were also studied.

Paraffin sections from all blocks were stained by Wilson's technique (16), and duplicate sections were treated to demonstrate acid-fast pigment and counterstained with aqueous Light Green (C.I. 670). Representative sections were stained by a number of other methods to demonstrate hemofuscin, hemosiderin, basophilia, etc., and were examined for fluorescence under ultra-violet light. In addition, a number of frozen sections prepared from selected cases were stained for fat (Wilson's technique, 16) and cholesterol (10).

Animal experiments. Artificial hemoceroid was prepared by incubating a mixture (37 C. for 5 days) of 9 parts of cod liver oil and 1 part of dog's washed erythrocytes according to the method previously reported (7). The centrifuged sediment was injected into the media and adventitia of the lower portion of a dog's abdominal aorta at several sites, using a needle and syringe. To accomplish this, the dog was subjected to laparotomy under anesthesia induced by intravenously administered nembutal. Attempts at subintimal rather than medial injection were unsuccessful. The abdominal incision was closed in layers, penicillin was injected intramuscularly, and the dog was allowed to recover. Blocks of the aorta at the sites of injection of artificial hemoceroid were taken at autopsy at the time of sacrifice three weeks later. Paraffin sections were prepared and stained in a variety of ways to demonstrate ceroid.

Through the courtesy of Dr. J. B. Firstbrook we were allowed to examine the aortas of a number of rabbits in which early stages of experimental atheromatous lesions had been produced by administration of cholesterol.

Results

Human tissues. In every lesion of the 25 aortas which exhibited atheroma in advanced stages, abundant deposits of acid-fast and sudanophilic pigment resembling ceroid could be demonstrated in paraffin sections (fig. 1). Similar pigment was found in every one of the miscellaneous series of atheromatous vessels examined (renal, iliac, femoral, and cerebral arteries). Positive reactions for ceroid were obtained also in 20 of the 23 coronary arteries examined (figs. 2 and 7). The 3 which gave negative reactions were then subjected to serial sectioning, for the original sections had included only thrombi, rather than the actual sites of atheromatous mural change. Positive reactions were found in all 3 when the additional sections were stained for acid-fast and sudanophilic material.

Multiple sections were prepared from each of the 10 aortas in early stages of atheromatous change. In these instances, in contrast to Burt's findings (3), ceroidlike pigment could be demonstrated in small amounts. In most

of the latter instances, the staining reactions of the material were weak and the type of pigment was classified as hyaloceroid (see below). Thrombi (unassociated with atheroma) in pulmonic, portal, splenic, jugular, and iliac vessels were free of ceroidlike products in paraffin sections.

Hemoceroid and hyaloceroid. The largest deposits of intensely staining (acid-fast or oil red O techniques) pigment were always found in association with areas of hemorrhage or deposits of hemosiderin in or beneath the thickened intima (figs. 3, 6, and 7). In these regions, individual red cells could sometimes be identified which gave positive reactions for lipid in the paraffin sections and which exhibited the phenomenon of acid-fastness (fig. 7). As hemorrhages were always in greatest evidence in the more advanced lesions, it is in the latter that the largest deposits of strongly reacting pigment were constantly found. This type of ceroid, associated with extravascular collections of erythrocytes, exhibited a granular appearance and, for reasons considered in the discussion, has been named *hemoceroid*. It may be defined as a strongly acid-fast, sudanophilic pigment resembling ceroid which occurs as granular, clumped deposits of highly refractile material situated in the immediate vicinity of hemorrhages in atheromatous lesions. Hemoceroid is closely related also to deposits of hemosiderin, for the two pigments nearly always occur in the same areas of the lesions (figs. 5 and 6). Most of the ceroidlike pigments identified in atheromatous lesions seemed to be of the hemoceroid variety. Hemoceroid is strongly autofluorescent, emitting a greenish-yellow color by ultraviolet light.

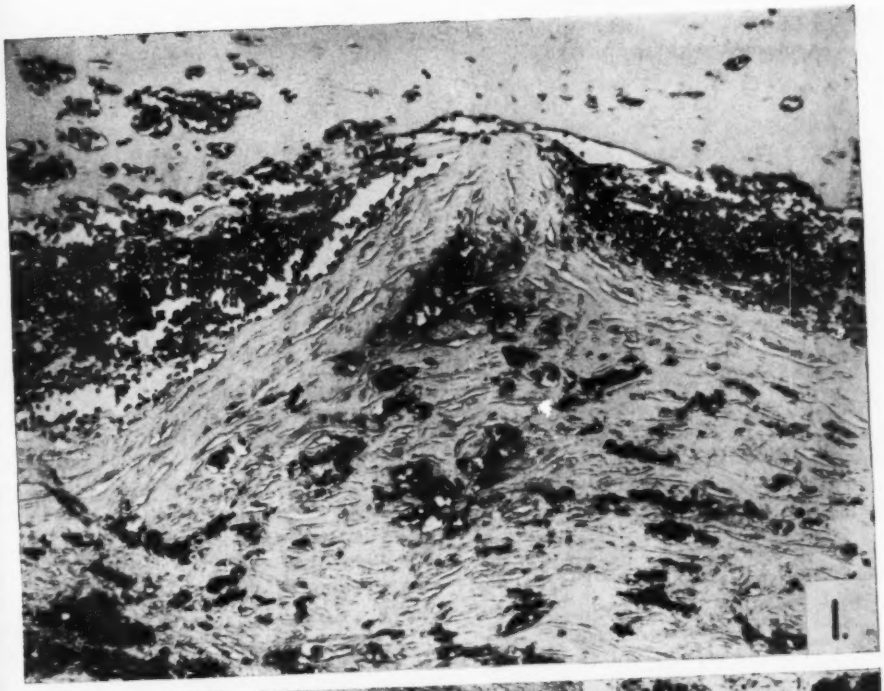
Hyaloceroid is the name given to the second type of ceroidlike pigment encountered in the atheromatous lesions. It is characterised by its smooth, glassy appearance, its weakly positive reactions to the tests for acid-fastness, sudanophilia, and fluorescence, the absence of nearby hemorrhages or hemosiderin deposits, and its constant association with hyalinized tissue (fig. 4).

Hyaloceroid was identified in some of the earliest atheromatous lesions in aortas and in many of the cerebral arteries in which hemoceroid could not be demonstrated. It was found, almost without exception, around the edges of clefts in hyaline tissue in the deeper portions of thickened intima. Frozen sections of similar regions revealed that the clefts were filled with stainable fat which seemed to be triglyceride, for it was negative to histochemical tests for cholesterol (10) and for phospholipid (1, 2) and it stained rose-violet with Nile Blue Sulfate (15). It seemed that this type of ceroid could be formed in association with hyaline tissue, independently of hemorrhages, and the name *hyaloceroid* was therefore given to it.

Animal experiments. Neither hemoceroid nor hyaloceroid was found in the atheromatous lesions induced in rabbits by the administration of cholesterol. Artificial hemoceroid was injected into the aorta of a dog to study the tissue reaction that might be induced by this means. A typical result from one of these injection-sites is shown in figure 8. Abundant hemoceroid (injected) was found throughout, and wherever the pigment was located it was embedded in fibrous tissue. At the time the animal was sacrificed (three weeks after in-

FIG. 1. Thickened intima in atheromatous aorta of man; paraffin section stained with oil red O by Wilson's technique (16). A thrombus is adherent to the intimal (upper) surface. The dark masses in the thickened intima are hemoceroid deposits. Less sudanophilic hyaloceroid around the margins of the clefts in the hyaline tissue does not show at this magnification. Wratten B and G filters; x200.

FIG. 2. Atheromatous coronary artery of man; paraffin section stained by Wilson's oil red O technique (16). Masses of hemoceroid can be seen in almost every part of the thickened intima as small dark clumps. The inset (upper right) is an enlargement of a typical area of hemoceroid deposition. Note the red blood cells (pale grey circles) intermixed with (black) granules of hemoceroid. Wratten B and G filters; x40 and x400.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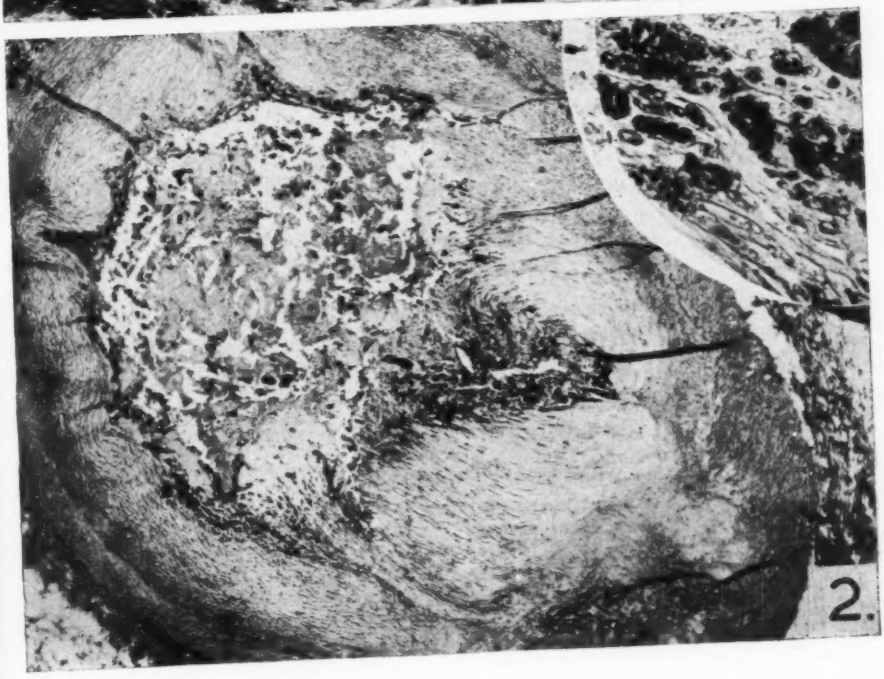
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jection) there was a remarkable absence of any appreciable degree of infiltration by inflammatory cells, but abundant fibrosis had developed around the clumps of granular hemoceroid (fig. 8). The overlying intima at the site of injection seemed essentially normal.

Discussion

Hemoceroid.—We believe that the type of ceroidlike pigment we have termed hemoceroid is the product of the interaction of abnormal deposits of lipid and extravasated red cells in areas of hemorrhage in human atheromatous lesions. This view is supported by the previously published results of the *in vitro* and *in vivo* production of ceroidlike pigments from mixtures of fat and red blood cells, as reported by the author (7) and by Casselman (4).

The hemoceroid of atheroma closely resembles the product of these experimental procedures in that it is highly refractile, clumped, and granular, and exhibits intense degrees of acid-fastness, sudanophilia, and fluorescence. Juxtaposition of hemoceroid with hemorrhages and hemosiderin deposits, taken together with the finding of individual erythrocytes which are sudanophilic and acid-fast, constitutes strongly presumptive evidence that it probably arose from the interaction of red cells with lipid in atheromatous lesions. For these reasons, the term hemoceroid seems to be justified, and it possesses the additional advantage of providing a term other than ceroid for these deposits, since the original definition (12) of ceroid applied only to the pigment found in fibrous trabeculae of cirrhotic livers and did not include that which might be found in other sites such as vessels.

Hemoceroid resembles liver-ceroid more closely than does hyaloceroid, a finding to be expected from the probable pathogenesis of the pigment in cirrhotic livers, since we have presented evidence (8) that in choline-deficient rats most of the ceroid results from small hemorrhages into the fat within pathologic cysts.

Hyaloceroid. The morphologic criteria by which hyaloceroid may be identified and distinguished from hemoceroid have already been presented. Hyaloceroid resembles that form of ceroidlike pigment which is produced *in vitro* when tissues other than red cells are incubated with suitable lipids (4) in that the degree of sudanophilia, acid-fastness, and fluorescence are not great and the pigment lacks the granular, refractile appearance of hemoceroid presenting instead a smooth, glassy surface.

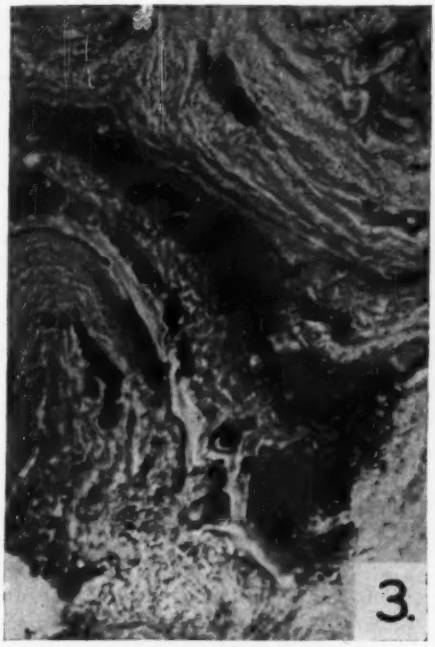
The presence of hyaloceroid around the margins of clefts in hyaline tissue which contains stainable fat suggests that it is the latter that has been converted into weakly acid-fast and sudanophilic material of sufficient insolubility in alcohol and xylol to be retained in paraffin

Fig. 3. Masses of hemoceroid in thickened, sclerotic intima of atheromatous aorta of man; paraffin section stained by Wilson's oil red O technique (16). This demonstrates the clumped, granular and refractile appearance as well as the intense sudanophilia (dark) of this type of ceroidlike pigment. Wratten B and G filters; x600.

Fig. 4. Hyaloceroid rims the margin of this cleft in intimal hyaline tissue of an atheromatous cerebral artery in man. Paraffin section; Wilson's oil red O stain (16). Except for its peripheral rim, the hyaloceroid is smooth and only palely sudanophilic. In the photograph, the hyaloceroid appears only slightly greyer than the hyaline surrounding it. Wratten B and G filters; x600.

Fig. 5. Hemosiderin in thickened intima of atheromatous aorta of man; paraffin section stained by Perl's method (10). The dark masses of hemosiderin lie intermixed with red blood cells (pale circles). Compare with figure 6, which shows a duplicate section of this area stained to demonstrate hemoceroid. Wratten B filter; x600.

Fig. 6. Comparable area to that shown in figure 5 in a duplicate section of the same block of aorta, stained by Wilson's (16) method. The dark masses of hemoceroid are intermingled with the palely stained red cells, in a manner comparable to the distribution of hemosiderin. This suggests that hemoceroid as well as hemosiderin is related in its pathogenesis to extravasated red cells. Wratten B and G filters; x600.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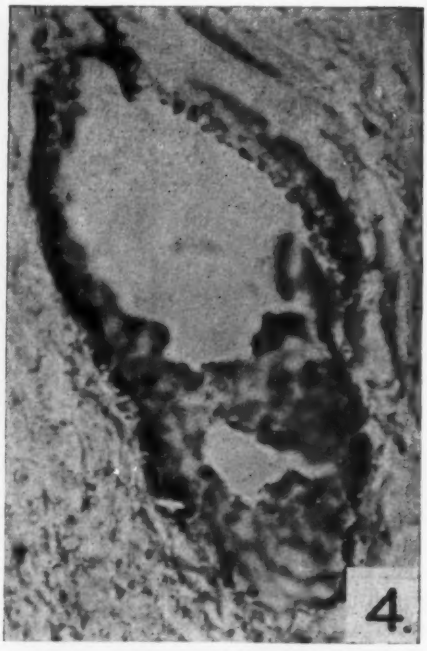
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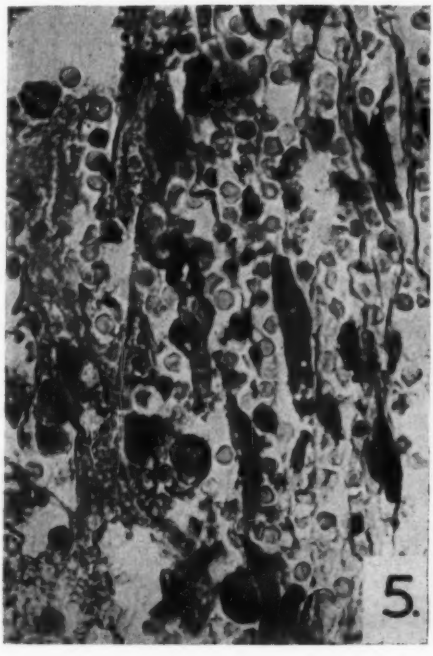
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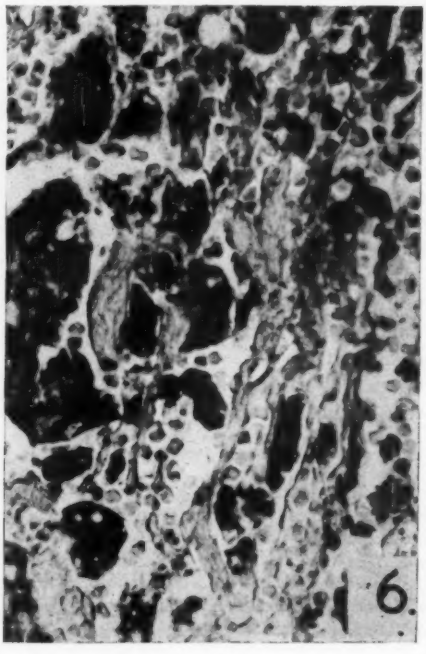
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sections. This alteration may be the result of autoxidation and condensation of lipid products on the surface of the hyaline.

As the latter tissue would not be expected to be as active in this regard as the hemoglobin-containing red cells, it is in accordance with the theories set forth here that the resulting product would not be as abundant or as strongly sudanophilic as hemoceroid.

Significance of hemoceroid and hyaloceroid in atheroma. From the foregoing, it is apparent that if the concept presented here of the pathogenesis of these ceroidlike pigments is accepted, they must then, *ipso facto,* be regarded only as secondary products in the natural history of the lesion. For hyaloceroid to be formed, it would be necessary first for abnormal deposits of fat to be deposited in thickened, hyalinized intima. For hemoceroid to be formed, hemorrhages must have occurred in preexistent lesions in which abnormal amounts of fat were present. On this basis, neither hyaloceroid nor hemoceroid could be regarded as primary etiologic factors in the production of atheromatous lesions. The presence of this very insoluble pigment may, however, play a part in the apparently irreversible nature of the lesions.

The experiment in which artificial hemoceroid was injected into a dog's normal aorta suggests that under these conditions the pigment is capable of stimulating the growth of fibrous tissue.

It may be that in man the presence of ceroidlike products contributes to sclerosis and that their insoluble nature adds to the difficulty encountered in attempts to produce regression of advanced atheromatous changes.

Our findings agree with those of Burt (3) in that abundant deposits of the strongly sudanophilic substance (hemoceroid) are found only in advanced lesions in which hemorrhages have occurred. Our results differ from his, however, in that even in early atheromatous lesions we found deposits of the weakly sudanophilic pigment, hyaloceroid. It is possible that Burt did not consider that the palely staining deposits of hyaloceroid gave sufficiently strong reactions to the various tests for ceroid to be counted as positive. In any case, we agree entirely with Burt's conclusion that the "weight of available evidence appears to indicate that this pigment is associated with degeneration of the vessel and is not a primary etiologic factor in the atherosclerotic process."

Summary

1. Independent confirmation is provided for Burt's report (3) of ceroidlike pigments in aortas of man exhibiting atheromatous change.

2. In addition to the aorta, ceroidlike pigments have been demonstrated in the coronary, cerebral, renal, iliac, and femoral arteries at sites of atheromatous lesions.

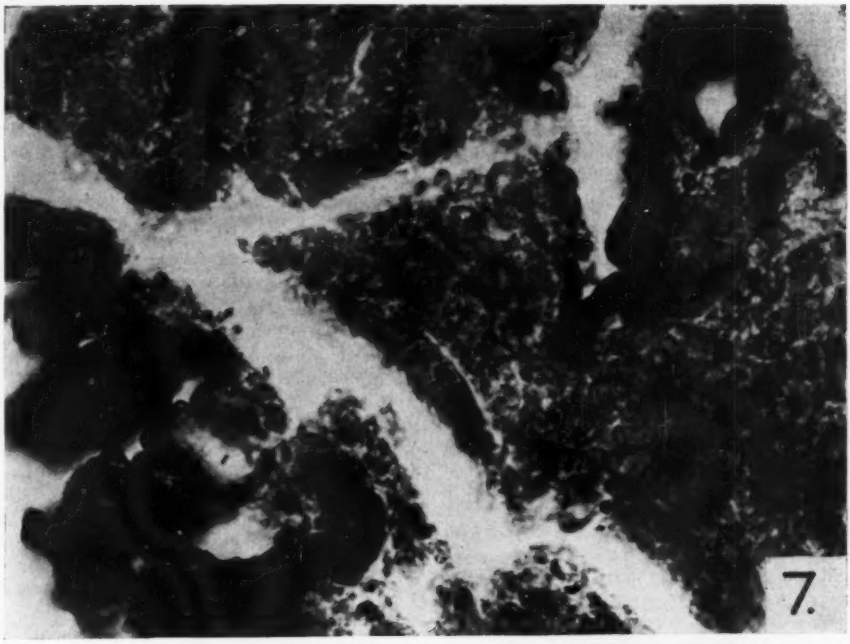
3. On the basis of previous work by the author (7) and by Casselman (4), and of the appearance of the pigments in micro-sections of the atheromatous vessels, two types are described and the names hemoceroid and hyaloceroid proposed.

4. Hemoceroid is defined as the intensely sudanophilic, acid-fast, autofluorescent pigment found in paraffin sections of atheromatous vessels. It possesses a highly refractile, granular, and clumped appearance and is constantly found in association with areas of hemorrhage and deposition of hemosiderin.

5. Hyaloceroid is the name given to the weakly sudanophilic, acid-fast, autofluorescent

Fig. 7. High power view of masses of hemoceroid (black) and red cells (clumped grey masses) intermingled in an atheromatous aorta of man. Note that individual erythrocytes, which have become sudanophilic, appear as black discs scattered throughout the paler clumps of red cells. Paraffin section; Wilson's oil red O stain (16); x1000.

Fig. 8. A dark mass of artifically prepared hemoceroid (see text), which had been injected into the media of a dog's aorta, is shown in the center of the field. Note the absence of infiltration by inflammatory cells and the presence of fibrosis. Paraffin section; Wilson's oil red O stain (16); x800.



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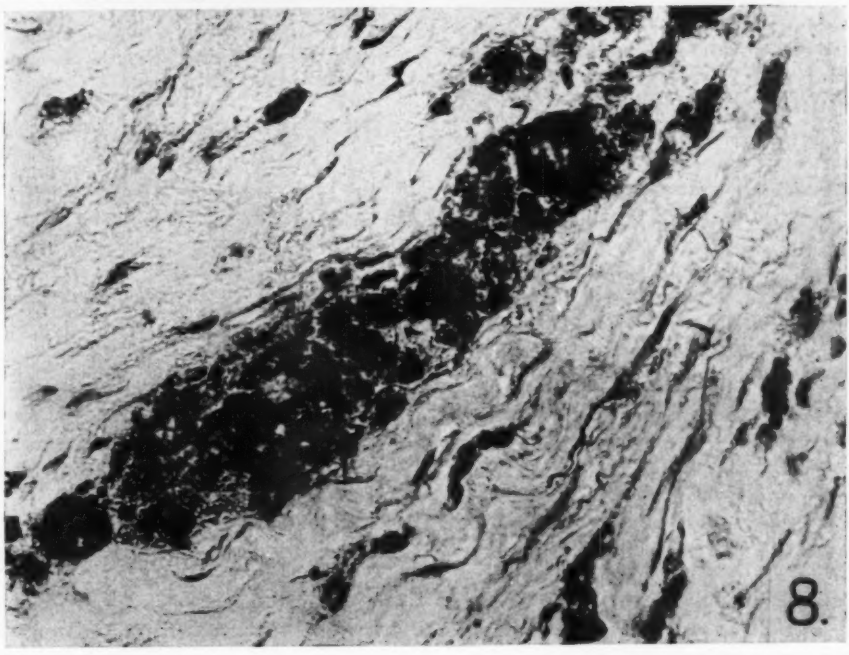

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pigment which is found in paraffin sections of atheromatous vessels. It possesses a smooth, glassy appearance and is found on the rims of hyaline tissue bordering clefts that in frozen sections contain stainable fat.

6. It is suggested that hemoceroid and hyaloceroid are secondary products which, although probably formed early in the development of atheromatous lesions, should not be regarded as primary etiologic factors in the production of the latter. Indirect evidence is presented which suggests that hemoceroid may be responsible for stimulating some of the fibrous elements of the lesion and contributing to the apparent irreversibility of advanced atheromatous changes.

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A summary of this investigation was presented at the Scientific Proceedings of the Forty-ninth Annual Meeting of the American Association of Pathologists and Bacteriologists, April 10-12, 1952, New York City, and appears in abstract form in *Am. J. Path., 28:* 526-527, 1952.

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The Correlation of Electroencephalographic and Clinical Observations in Psychiatric Patients Over 65

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It has been commonly observed that the electroencephalograms of many patients in the older age group show a high percentage of abnormalities with a characteristic slowing of the dominant rhythm. To what extent the degree of abnormality or the slowing of the dominant rhythm is related to clinical signs of mental impairment has not been definitely established. However, according to the literature, which will be discussed later, it is believed that some correlation exists. The present paper is concerned with the relationship between clinical and electroencephalographic observations in elderly patients studied at the Worcester State Hospital. The particular kind and severity of the clinical findings will be compared with the type and extent of the electroencephalographic abnormality.

Method

One hundred and ten patients 65 to 86 years of age (84 male and 26 female) recently admitted to the Worcester State Hospital were selected for study. The patient's ability to cooperate for electroencephalographic study was the most important selective factor.

The patients were divided into 4 main groups depending on their psychiatric diagnoses. These included 24 cases of senile psychosis, 33 cases of psychosis with cerebral arteriosclerosis, 19 cases of psychosis associated with organic changes of the nervous system, including 2 cases of brain tumor, and 34 miscellaneous cases. The miscellaneous group included 6 cases of manic-depressive psychosis, 5 of involutional psychosis, 3 of schizophrenia, 2 of paranoid condition, 6 cases without psychosis, 1 case of psychoneurosis, 1 case of primary behavior disorder, 1 case of psychosis with mental deficiency, and 9 cases of toxic psychosis. The toxic psychoses comprised 5 cases of alcoholic psychoses and 4 cases with serious somatic disease; the latter included 2 cases of psychosis associated with metabolic diseases and 2 of psychosis associated with disturbances of circulation.

Each patient was studied clinically with special consideration for the following categories: stream of talk; recent, remote and retentive memory; orientation for time, place, and person; state of consciousness in terms of degree of clouding; general knowledge; comprehension; emotional status; delusions or hallucinations; personal appearance; degree of helplessness; continence of urine and feces; motor activity; neurologic changes such as tremors, aphasia, motor incoordination, paresis or paralysis; signs of cardiac decompensation. The blood pressure was recorded. In the history, conditions such as alcoholism, weak or fainting spells, convulsions, and cerebrovascular accident were noted.

Wherever possible, a quantitative estimation of a defect was made by rating the impairment as slight, moderate, or severe. This method was particularly useful in evaluating such categories as memory, state of consciousness, comprehension, general knowledge, personal appearance, and degree of helplessness. The stream of talk was rated on the basis of pronunciation (dysarthria), coherence, and relevance of the associations. Disturbances in the emotional status were denoted by descriptive

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terms such as labile, elated, euphoric, bland, flat, apprehensive, agitated, or depressed. Other functions were indicated as being present or absent, normal, or abnormal.

The electroencephalographic study was undertaken with the patient in the supine position in a dimly lit room. A four channel electroencephalograph was used to record electrical potentials from 9 electrodes located as follows: 1 vertex electrode placed in the midline, halfway between the nasion and inion; and 4 pairs of symmetric electrodes placed over the frontal, temporal, parietal, and occipital lobes, respectively. A tenth electrode used as a ground was placed on the left ear lobe.

Bipolar leads were used exclusively and every possible combination between the 9 electrodes was recorded for a period of sixty seconds. When artefacts could not be ruled out, additional recordings were taken at a later time.

The electroencephalograms were then studied for generalized or focal abnormalities. Any record showing an alpha wave frequency between 8 and 13 per second with no focal signs was considered normal (5). When the alpha rhythm was within normal limits but when there were occasional localized or generalized waves with a frequency of less than 8 per second the record was considered abnormal. A dominant frequency of less than 8 per second without focal signs was classified as theta or delta activity and therefore abnormal. Each record was studied as a whole, although particular note was taken of frontal and occipital alpha rhythm.

Each electroencephalogram was classified as either normal or abnormal; the dominant alpha, theta, or delta rhythm was determined, and presence of focal changes was noted. When there was a mixture of alpha, theta, or delta waves in approximately equal amounts, the average wave frequency was taken as the dominant rhythm.

Observations

In the individual case there was no correlation between age and degree of electroencephalographic abnormality. Thus, a patient of 65 might have a grossly abnormal electroencephalogram, whereas a patient of 80 often showed a completely normal record. The patients with abnormal electroencephalograms had an average age of 74.4 years, while those with normal records had an average of 72.1 years.

The distribution of the electroencephalographic abnormalities in the various diagnostic categories is presented in table 1.

TABLE 1. DISTRIBUTION OF ELECTROENCEPHALOGRAPHIC ABNORMALITIES

Diagnosis	Electroencephalogram		
	Normal	Abnormal	Total
Senile psychosis	7	17	24
Psychosis with cerebral arteriosclerosis	9	24	33
Psychosis with organic changes of the nervous system	3	16	19
Miscellaneous:			
Functional	22	3	25
Alcoholic	4	1	5
Somatic diseases	2	2	4
Total	47	63	110
Per cent	43	57	100

Of the 63 abnormal records 57, or 90.5 per cent, occurred in the groups which comprised senile psychoses, psychoses with cerebral arteriosclerosis, and psychoses associated with organic changes of the nervous system.[1] Of 76 patients in these groups which show a predominance of symptoms of organic mental deficit associated with the processes of aging, 57, or 75 per cent, had abnormal electroencephalograms.

Contrasted with the organic cases were the 25 patients with functional conditions such as

[1] The great majority of the cases classified as psychosis associated with organic changes of the nervous system were probably cases of senile or arteriosclerotic disease, or mixtures of both, in which the historical data were insufficient to warrant a more specific diagnosis.

manic-depressive psychosis or schizophrenia, of whom only 3, or 12 per cent, showed electroencephalographic abnormalities.

Considering the clinical evaluation in its entirety, the most consistent indicators of mental impairment seem to be stream of talk, lack of memory, and disorientation. A patient who is well oriented and has only slight or moderate memory impairment will tend to have a clear state of consciousness with a comparable ability for comprehension. In most cases his grasp of general knowledge will be in keeping with his memory defect. Such a person will be reasonably careful in his personal appearance and ordinarily will not require assistance in dressing, feeding, or toileting himself. When a patient displays abnormalities of speech, marked to severe disturbances of memory, and a varying degree or disorientation, he will almost invariably show a cloudy or confused state of consciousness with a marked or severe impairment of comprehension. Such a patient is usually neglectful of his personal appearance and requires some assistance in dressing, eating and toileting. The degree of continence was, in most cases, similarly related to the state of consciousness, personal appearance, and degree of helplessness.

In view of the foregoing observations, the stream of talk, orientation, and memory were the 3 functions selected for particular attention in attempting to correlate mental symptoms with electroencephalographic changes. A patient whose stream of talk was normal, who was oriented for time, place, and person, and whose memory showed only mild to moderate impairment was given a 0 rating. Those who exhibited abnormalities in only one of the 3 categories, such as partial or complete disorientation or marked memory impairment, were rated as 1. Where 2 out of the 3 categories showed definite abnormalities a rating of 2 was given. Those who displayed marked to severe memory impairment, were partially or completely disoriented, and exhibited abnormalities in the stream of talk were rated as 3. The ratings were then compared with the electroencephalographic results in each case. The data are represented in table 2.

TABLE 2. CORRELATION BETWEEN SYMPTOMS (STREAM OF TALK, ORIENTATION, MEMORY) AND THE ELECTROENCEPHALOGRAM

Degree of Disturbance in Clinical Symptoms	Electroencephalogram		
	Normal	Abnormal	Total
0	33	8	41
1	7	8	15
2	4	18	22
3	3	29	32
Total	47	63	110

When measured in this way a more than accidental correlation was found between the extent of clinical impairment and the degree of electroencephalographic abnormality. Thirty-three of 41 patients who were rated as 0 had normal electroencephalograms. Twenty-nine of 32 patients who were rated as 3 had abnormal records. The remaining patients formed a continuum between the two extremes, bearing out the correlation; 11, or approximately 10 per cent, of the 110 patients failed to conform.

However, of all the 11 exceptional cases, 5 which were classed as abnormal in their electroencephalographic findings showed only minimal changes and might have been considered borderline. Two of the others were possibly borderline. In the remaining 4 patients a review of the clinical and electroencephalographic findings did not reveal any possible explanation for the apparent incongruity.

It is interesting to note that of 5 patients with chronic alcoholic psychoses, including 3 patients with Korsakoff's psychosis, only 1 showed an abnormal electroencephalogram. This is probably consistent with the fact that clinical evaluation of these particular patients indicated only slight to moderate mental impairment.

The importance of disturbances of motor activity was also considered. Eighteen patients showed varying degrees of underactivity, while

25 patients were overactive. Of the 43 patients showing motor disturbances, 31, or 71.1 per cent, had abnormal electroencephalograms. These showed a relatively equal distribution among the diagnostic categories. Disturbances of motor activity are probably not in themselves good indicators of organic damage since they are frequent in the majority of psychiatric disorders. The same seems true for symptoms of emotional disturbance.

The presence of delusions and hallucinations was also noted. Twenty patients showed delusions while 8 of these had hallucinations in addition. Nine of the 20 patients had abnormal electroencephalograms. Although patients with organic mental disease can have delusions and hallucinations, these symptoms are most frequent in so-called functional psychoses and transient toxic conditions. In fact many of the patients with delusions and hallucinations in this series showed only mild to moderate signs of organic deficit. The observations indicate that these symptoms are not of importance in a correlation with electroencephalographic findings.

With respect to blood pressure, 59, or 53.6 per cent, of the 110 patients showed an elevation above 140 systolic or 90 diastolic. Thirty-eight, or 64.4 per cent, of these 59 patients had abnormal electroencephalograms. There is apparently no significant relation between elevated blood pressure and electroencephalographic changes.

Discussion

The most frequent electroencephalographic finding was slowing of the dominant rhythm to 8 or less per second. This occurred in 82, or 74.5 per cent, of the 110 patients. The average dominant rhythm for all 110 patients was 7.2 per second. Patients with normal electroencephalogram showed an average dominant rhythm of 8.6 while those with abnormal records showed an average of 6.4 per second. Thirteen, or approximately 50 per cent, of the 25 patients with functional psychiatric conditions had a dominant rhythm of 8 per second. If such patients who showed a minimum of organic signs and symptoms can be considered representative of the so-called normal population 65 or over, it might be concluded that about half of the general population in this age group would show a tendency toward slowing of the alpha rhythm.

The presence of focal signs such as localized bursts of 2 to 5 per second waves or random spiking was common and more notable in patients diagnosed as having psychosis with cerebral arteriosclerosis and psychosis associated with organic changes of the nervous system. It is suspected that in most instances such foci result from localized vascular lesions or scar tissue resulting from previous cerebrovascular accidents. Focal signs in most cases occurred in records having a dominant rhythm of less than 8 per second. An occasional record showed a low voltage pattern with considerable beta activity. The significance of such patterns could not be determined.

The literature is in agreement as to the increased frequency of electroencephalographic abnormalities in the older age groups and in organic mental conditions. The writings of Gibbs and Gibbs (2), Davis (1), Hoch and Kubis (4), Liberson and Sequin (6), Greenblatt and associates (3), Stoller (9), Schwab (8), and Obrist (7) confirm the observation that marked slowing of alpha rhythm is the most common deviation from normal in these conditions.

Hoch and Kubis (4) believed that a correlation existed between electroencephalographic and clinical status of the patient in cases of general paresis, senile psychosis, psychosis with cerebral arteriosclerosis, and alcoholic psychosis (Korsakoff type), although such correlation was by no means absolute. In some cases they found a parallelism between the degree of mental impairment and the electroencephalographic findings. They emphasized the importance of differentiating clearly between persons who have only neurologic manifestations of organic disease and patients who also have mental changes.

Several authors, including Schwab (8), Stoller (9), Hoch and Kubis (4), found more prominent alpha rhythm slowing over the fronto-motor areas, despite the generalized occurrence of this change. In our studies such localized changes were not prominent.

Liberson and Sequin (6) studied 53 arteriosclerotic and senile patients from both the clinical and electroencephalographic points of view. The clinical symptoms of most value to them in their study were confusion, irritability, agitation, anxiety, delusions, depression, and hallucinations. They disregarded memory disorders, believing that they were obscured by confusion. This is in contrast to our study where we attempted to segregate as accurately as possible more or less specific organic symptoms such as memory impairment, speech disorder, or disorientation from symptomatology which might occur on either a functional or organic basis. They concluded that organic lesions associated with anxiety, agitation, and delusions were less apt to show a marked electroencephalographic abnormality and they suggested a relationship to involutional psychosis in this group of patients.

Greenblatt and associates (3) at the Boston Psychopathic Hospital analyzed the electroencephalograms of 1593 neuropsychiatric cases, classifying them as normal or abnormal. Of their 37 cases of either senile psychosis or psychosis with cerebral arteriosclerosis, 54 per cent had abnormal electroencephalograms. Our studies showed that 75 per cent of our 76 patients with similar diagnoses had abnormal electroencephalographic tracings. The discrepancy may perhaps be explained by our larger series and by the supposition that many of our cases may have presented more advanced organic disease than those at the Boston Psychopathic Hosptial, which uses some degree of selectivity in its admission procedures.

Summary

1. Clinical and electroencephalographic observations on 110 patients 65 to 86 years of age (84 male and 26 female) are presented.
2. Fifty-seven per cent of the 110 patients had abnormal electroencephalograms.
3. The most frequent electroencephalographic abnormality was slowing of the dominant rhythm to a frequency of less than 8 per second.
4. Seventy-five per cent of patients with the diagnosis of an organic condition such as senile psychosis, psychosis with cerebral arteriosclerosis, and psychosis associated with organic change of the nervous system had abnormal electroencephalograms, whereas only 12 per cent of patients with the diagnosis of a functional psychiatric condition showed electroencephalographic abnormalities.
5. There was no correlation in the individual case between age and electroencephalographic abnormality.
6. In general the patients having normal electroencephalograms were those who showed moderate or no indications of organic mental deficit.
7. The 3 most reliable factors for quantitatively evaluating the severity of the clinical symptoms in this age group seem to be stream of talk, orientation, and memory. When measured by these functions, there was a direct correlation between the severity of the mental impairment and the frequency of electroencephalographic abnormalities in 90 per cent of the cases.
8. Symptoms such as delusions or hallucinations, disturbances of motor activity or emotional status, which are common in many functional psychiatric conditions, showed no definite relationships to the electroencephalographic disturbances.
9. In attempting to correlate electroencephalographic and clinical observations, one must distinguish between signs and symptoms related to organic mental deficit and those occurring in psychiatric conditions of a so-called functional type.

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Surgical Restorative Art for the Aging Face

Notes on the Artistic Anatomy of Aging

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THE desire to appear well and youthful is entirely reasonable and human; often this wish is stimulated by economic and psychologic necessity. People have valued youth and beauty as long as men can remember.

The plastic surgeon can advise elderly patients about the visual effect of old age and of what means can really be employed to delay the *appearance* of old age, and thus make life more useful and happier for old people in a younger society. Or to rephrase it, the plastic surgeon can advise older people about methods by which they can appear younger and thus be happier in a society which places a premium on youthful features.

In order to be able to make an aged face more youthful, one must know the anatomic and artistic difference between the face of the youthful individual and the face of the older person.

Surprisingly enough, not much about the artistic anatomy of the youthful and the aged face is recorded in the medical literature. But early in the Sixteenth Century, that versatile genius, Leonardo DaVinci, great artist and assiduous anatomist, walking the streets of Florence, made sketches and anatomic studies of people of various ages. From Leonardo and that other great draftsman, Albrecht Dürer, we can approximate some rules of artistic anatomy which indicate to us what seem to be the rules of proportion of youthful and aged faces.

The face of the young and beautiful individual can be divided into three areas of equal vertical space. These can be called the area of the forehead, of the nose, and of the mouth and chin (fig. 1c).

The critical vertical dimension is the area of the lower third of the face. This area is from the bottom of the nose to the bottom of the chin (fig. 8).

In the youthful and beautiful face, these three areas are of *equal* vertical dimension. When they are equal, the face can be said to be youthful, in balance, and artistically appealing.

The etiology of facial senescence must be understood before surgical intervention is attempted. The facial contour is normally guaranteed fixedness and integrity by three broad rings of muscles. Two are the orbicularis oculi encircling the eyes. The third is the orbicularis oris, the thin band of muscle stretched around the mouth. All three muscle bands are held in balance with each other by their attachments with the other facial muscles.

The zygomatic major muscle which is attached to the lateral corner of the orbicularis oris loses length and mobility. As it becomes more fixed it causes characteristic folds near the mouth. The platysma muscle loses tone and becomes more fibrous and the skin below the chin may "double," if the person is fat, or becomes redundant, if the person is thin (fig. 10a).

As age approaches a few teeth are lost. The remaining molars are ground down by mastication and well known dental phenomena occur. They lose some vertical dimension intrinsically. There is some absorption and diminution of the size of the mandible, and the anterior upper and lower incisor teeth tend to deviate their occlusal surfaces anteriorly. Thus, there is loss of vertical dimension of the lower third of the face (fig. 10a, 11a, 12a).

With these anatomic changes the masseter muscle loses tone. The loss of muscle tonus

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as a factor in facial aging is apt to be belittled. Illustrated is a face with a unilateral facial paralysis (fig. 2). Note the difference in apparent age between the two sides of the face. The loss of vertical dimension plus the atrophy of the areolar connective tissue results in the accentuation of the nasolabial fold and the skin of the cheeks becomes pendulous.

The proportion of yellow elastic fibers in the skin varies widely, but as years advance the histologic picture of the connective tissue below the skin changes to show an increase of collagenous tissue and a change in physical properties and arrangement of the elastic fibers. There is also diminution of muscle volume of the facial musculature with age.

Thus, so far we have mentioned that as age advances, the skin becomes atrophic, as does its connective tissue attachment to the muscles below it, and the facial muscles themselves. The teeth wear down and lessen the vertical dimension of the lower third of the face. Bone absorption occurs in the mandible and other facial bones. The chin, therefore, is closer to the nose than in youth (fig. 1a).

Further, as age advances, the elastic tissues of the nose also atrophy, and the nose slowly responds and elongates in vertical dimension. The chin goes up and the nasal tip goes down. The skin of the cheeks begins to hang in crepey wrinkles, bags, and folds, for it now no longer is as fully filled by its skull, teeth, and its other contents, as in youth.

Baggy eyelids also tend to give the face an atmosphere of advancing years and decrepitude. Overhanging upper lids are very seldom caused by anything other than redundancy of aging skin. Sometimes this redundancy is great enough to occlude vision.

Several plastic surgical methods can be used to ameliorate this aging effect: 1) the face lift, 2) shortening of the nose, 3) removal of bagginess of the eyelids.

The Face Lift

One method, the face lift, excises the excess facial integument and re-applies the tightened skin of the cheeks to a higher and more youthful position upon its underlying muscles. There it is anchored, with the tell-tale sutures hidden behind the hairline and behind the ears. The amount of skin to be removed is best judged with the patient in an upright position. The skin of the cheeks is drawn backward and upward with the fingers, and the appropriate areas for excision are marked with a dye. If the skin is drawn too tightly, the nasolabial fold is entirely obliterated. This tautness lends a distorted appearance to the mouth.

The incisions are made inconspicuous by concealing them as much as possible in the hairline. The incisions of the angle of the ear are concealed by the overhanging ear lobe.

Surgical Procedure

The patient's hair is shaved in the temporal area and behind the ears. A wide strip of sterile adhesive bandage is laid along the surgical area border so that the hair does not intrude into the surgical field. The face and adhesive strips are painted with a mercurous antiseptic solution.

The surgery is conducted with a 1 per cent novocaine with adrenalin anesthetic. The needle is inserted into the ear lobe, then follows the line of projected incision. From this line, the anesthetic is injected anteriorly toward the outer canthus and to the nasolabial fold, halfway to the chin, along the body of the mandible and along the sternocleidomastoid for several inches.

A triangular section of the ear lobule is excised as illustrated, (fig. 3) and the lobe resutured (fig. 4). This is to accent the curvature of the ear lobe against the slight tension to which it will be opposed later. The incision is then carried upward along the anterior edge of the auricle and into the hair area and forward and upward into the temporal area. A posterior limb of the incision passes under and posterior to the ear, in the postauricular sulcus. It passes into the hairline above the level of the tragus (fig. 5).

The margins of the skin to be resected are grasped with forceps along the entire incision. Lahey, Allis, or Kocher forceps or towel clips may be used. I use a T shaped forceps, originally designed for spinal operations (fig. 6). The skin is undermined as extensively as the particular need indicates. Generally, the undermining is carried near to the outer canthus, the undermining radiating to the nasolabial fold and over the sternocleidomastoid muscle (fig. 6). The undermining operation is confined above the fascia.

By protecting the fascia, the temporal branches of the facial artery, nerve, and vein are uninjured. Further, the fixation or anchor sutures are more effective with an undisturbed fascia. The anchor sutures are placed as follows:

1. canthus area toward temporal area,
2. nasolabial area toward the auricle,
3. from along the body of the mandible toward the ear lobe,
4. from along the sternocleidomastoid area toward the postauricular sulcus.

Once the fixation of the fascia is completed, the forceps are pulled upward and backward, drawing the skin over the ear until the face is smooth, but not artificially taut (fig. 6).

With the skin now repositioned, being literally *rotated* upward in the direction of the temporal area and backward toward the auricle, the resection may proceed. While the skin is held in its new position with the forceps, under tension, the excess skin is trimmed away with scissors. The excision is most wisely begun at the critical ear lobule area. It proceeds forward up toward the temporal area, then posteriorly along the postauricular sulcus.

After four or five lineal centimeters are excised, the suturing of the skin should commence, beginning at the lobule. As the first few centimeters are sutured anteriorly along the auricle, the excision is extended ahead of the skin sutures, preceding it as the suturing progresses. Skin closure may be with fine sutures, interrupted or mattress type (fig. 7). Either cotton, nylon, or steel may be used. All are satisfactory. The incisions are protected with a wrap-around pressure bandage, with the ears adequately padded.

The operation is not completed until one is sure that there is no bleeding. Hematomas are to be guarded against.

Needless to say, one should, at the time of a facial rejuvenation operation, inspect the teeth with a view to restoring the vertical dimension of the mouth with dentures or other dental prostheses plump enough to literally *refill* the mouth with teeth. This will help to iron out the vertical wrinkles about the lips.

The effect of a face lift operation in 3 patients with premature facial senility is shown in figs. 10, 11, and 12.

Quite a perplexity to the patients contemplating facial rejuvenation by means of a face lift is how to "pass off" or explain their sudden facial youthfulness after surgery.

Many decide to change their coiffures and makeup before returning to their homes and occupations. Some develop suntans and change their spectacle frames. Some adopt sunglasses for a time. Most attempt to explain away their youthful and refreshed appearance to a pleasant vacation and rest in attempts to head off speculation as to whether the change was due to surgery.

These perplexities must be resolved by women who have facial surgical rejuvenation after the age of 45 years.

There is a growing group of women who do not wait for gross facial aging signs to appear. Many professional women, much before the public, seek only a partial face lift as soon as the first signs of wrinkling appear. Most of the time the surgery can then be limited to the temporal area, well behind the hairline, with no visible incision lines. The convalescent time is a week or two; thus the entire procedure can be accomplished during a short vacation; no explanation is necessary. It is practically a prophylactic procedure. Such individuals remain young and never need worry about radical facial changes. They seek minor face lifts every few years. Psychologically, they remain youthful, apparently inexplicably, while their friends around them age.

Often the upper lip shows up to poor advantage because the angle between the nose and upper lip is too acute (fig. 1a). For youthfulness and harmony, the nose-lip angle should be, in women, slightly more obtuse than 90 degrees and, in men, slightly more acute than 90 degrees. Sometimes it is possible to ameliorate this optical effect by adding plumpness to the upper anterior dental prosthesis, if the patient has such a prosthesis.

Shortening of the Nose

The plastic surgeon is often called upon to shorten the nose. One of the effects he seeks to achieve is to make the upper lip more visible, especially when the patient smiles. The elongated nose tends to cause the upper lip to seem shorter than it actually is. Plastic surgery can increase the vertical dimension of the upper lip by shortening the nose. It makes the upper lip easier to see (fig. 13).

Why is the large nose ugly, and why does its correction cause such remarkable improvement in the patient's appearance? Various factors of artistic anatomy are involved. Not knowing them, the operator will obtain only accidental or occasional good esthetic results for all varieties of hump nose. These factors are: 1) the artistic anatomy of the face, 2) the artistic anatomy of the nose, and 3) the laws of optics as applied to the artistic concept of the face.

Esthetically, the large nose has a specific optic effect on the appearance of the face. While the eyes of a normal face are about one eye-width apart, those of the patient with a hump nose always seem closer together than they actually are, as well as smaller and beadier. When a hump is removed from the nose, the eyes suddenly seem larger, wider apart, and more luminous. Conversely, the nasal hump catches highlights of overhead lighting, and the highlight between the eyes tends to make the eyes seem closer together, smaller, and beadier in appearance. Psychologically this gives the owner of the hump nose a crafty, cunning appearance. Another illusion that the hump nose generally creates is that of thinness of nose and face.

But what is important to consider, from the point of view of facial youthfulness, is the length of the nose. The long nose, especially with a long, overhanging tip, tends to increase the apparent length of the middle third of the face and creates an illusion of shortening of the vertical dimension of the lowest third of the face. It does this by its overhang, or concealment of the upper lip (fig. 13a and 14a). As pointed out, we associate age with decrease of vertical dimension of the mouth area of the face. A simple experiment will illustrate this axiom. Simply remove the dentures from a person's mouth. The lips cave in and even with the jaws kept at a position of physiologic rest, the vertical dimension is shortened and the individual seems more aged at once. (Is this not why people of advancing years avoid being seen without their dentures?) Ask the individual with removed dentures to bite, and the face becomes a caricature, with the nose almost meeting the chin, emphatically illustrating this concept of the importance of avoiding nasal encroachment on the vertical dimension of the mouth area, if the appearance of old age is to be forestalled.

If the nose is long or has a hanging columella, the upper lip seems to be thinner and narrower in its vertical dimension. Most of this is shadow effect, but esthetically the lower border of the nose should meet the lip at an angle of 90 degrees or more (fig. 13b). Practically every operation for hump nose requires that the nose be shortened in its vertical dimension anyway, because of the law of optics that the interrupted plane seems short and the uninterrupted plane long. The hump nose, even if it is long with the hump, will seem even longer if the hump is removed. The nose must be shortened, therefore, for two reasons: 1) correction of the actual length and 2) correction for the apparent increase in length due to the removal of the hump.

To see the aging effect of the nose on the face as a whole, before and after correction, the face should be considered in its sagittal plane and divided diagrammatically into four horizontal areas of equal vertical dimensions (fig. 1). The uppermost area, that reaching from the ideal hair line to the top of the head, is generally not considered in great detail. The other three areas are important: 1) from the ideal hair line to the root of the nose, 2) from the root of the nose to the junction of the nose with the lip (top to bottom of nasal base), and 3) from the columella to the bottom of the chin.

The diagram shows that, as previously mentioned, the nose occupies exactly the middle third of the vertical dimension of the face and that generally it is in the same horizontal position as the ear; it occupies the same vertical space.

An X is drawn through the root of the nose, its outward branch running parallel to the forehead and its inward branch extending down through the chin line (fig. 1c). The ideal nose does not extend anterior to this X, either at

the tip or along the ridge. The X has an angle of 25 to 30 degrees in normal persons. The normal nose does not extend below the line drawn through the nasolabial angle. All of these factors are esthetically important.

The lowest third of the face should be equal in vertical space to each of the upper portions, as indicated in the diagram (fig. 1). The vertical dimension of the area of the upper lip is ideally one-third that of the entire lip and chin area (fig. 8). In other words, the lowest third of the face is further subdivided into vertical thirds, with the upper lip occupying exactly the uppermost third of this space (fig. 8).

The nose itself is divided horizontally into five areas (fig. 9). These are based on the anatomic structure. The five spaces are vertically equal, and the upper two spaces exactly include the nasal bones. The lower three spaces include the nasal cartilages. The support of the upper two-fifths of the nose is by the nasal bones, rigid and unyielding. The lower three-fifths of the nose is supported by the nasal cartilages and the septum. The septum is the main buttress for the fleshy part of the nose, and the cartilages of the nares are accessory struts.

It is necessary to overcorrect when shortening the nose, because the columellar cartilage is thin and weak and when sutured up to its new position tends to fall back slightly. Experience alone determines the amount of overcorrection necessary.

Surgical Procedure

The details of the various surgical procedures followed to correct hump noses are described in the literature. All noses are not corrected to the same pattern. Each nose is remolded to fit the owner's face with as great exactness as possible, and the overcorrection necessary in areas containing soft parts, because of biologic limitations, are taken into account. It may be well to include here a few steps to follow to obtain a good cosmetic result. First, the patient is photographed. The profile is the most important view. On this photograph are noted the planes as illustrated in the diagrams. These show graphically the exact amount of deformity and serve as excellent records. Next a plaster negative impression is made of the face. From this, positive impressions in plaster may be made. The plaster model is also kept for the records.

When the hump is accompanied with widening, the removal of the hump is followed by complete separation of the stumps of the nasal bones from their maxillary sutures and repositioning of them so as to form a new pyramid with a narrower base. This operation requires a stabilizing splint to insure a cosmetically pleasing union. It is supplemented by anterior shaving of the ridge of the septal cartilage; usually the alae require narrowing.

It is also necessary to resect a triangular wedge of the septal cartilage at its columellar junction to shorten the nose, and it is necessary to reshape the alar and lateral nasal cartilages to make the nose itself intrinsically in proportion.

On the patient who has had a rhinoplastic operation, not only are the changes rhinoplastic in nature, but the whole face changes. The eyes seem larger, the upper lip shows to better advantage, and the face, on front view, seems less angular, more oval, and more youthful. The youthfulness can be attributed to the change in the apparent shortening of vertical dimension of the middle third of the face. The apparent rejuvenating effect of surgical shortening of the nose is demonstrated in figures 13 and 14.

REMOVAL OF BAGGINESS OF THE EYELIDS

Surgical Procedure

Bagginess of the upper eyelids is corrected quite simply by blowing up the ellipse of redundant skin with a novocain solution and excising the redundant skin with a curved scissors. The wound margins are approximated with very fine interrupted sutures. If the incision is over the area of natural crease of the upper lid, it becomes invisible when healed. The skin of the eyelids heals better and more promptly than the skin of perhaps any other part of the body.

Bagginess of the lower eyelids is more complicated. If it is due to a simple crepiness or bagginess of the skin, an incision is made just below the lid margin (fig. 15a). The excess tissue is drawn upward and laterally (fig. 15f), after the skin has been undercut, and the excess removed with a curved scissors. It is then sutured, as shown in figure 15g. A pressure dressing is applied for an hour or two for hemostasis. The wound heals with practically no mark.

However, most baggy lower eyelids conceal a herniation of fat literally rolling forward over the anterior edge of the floor of the orbit of the eye (figs.

16a, b, c, and d) . In this case, the incision is made (fig. 15a) along the lower lid margin. The incision is opened (fig. 15b), exposing the orbicularis oculi muscle. With two fine tweezers, the fibers of the orbicularis oculi are teased apart (note the direction of arrows on the thumb forceps) (fig. 15c). This exposes a yellow mass of fat, which rolls up from the gap in the orbicularis oculi muscle, as illustrated in figure 15d. The bulging fat is gently grasped with the forceps and excised with a scissors (fig. 15e). We have found that the muscle strands fall together and there is no need to suture them. The excess skin of the baggy lower lid is then drawn upward and laterally (fig. 15f) and excised. The skin margins are sewn together with one or two fine interrupted sutures and generally a fine subcutaneous continuous suture, which are removed in a couple of days.

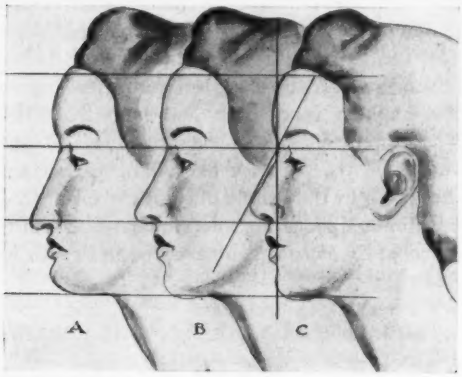


FIG. 1. The face divided into three areas of equal vertical dimensions:

A. the nose occupies more than one-third of the vertical dimension of the face, and the mouth and chin area has lost some of its vertical dimension. Note the apparent increase in age because of the optical effect.

B. the nose occupies a little more than one-third of the vertical dimension of the face. The lip and chin area is normal. Note the slight aging effect of the elongated nose as compared to,

C. in which the nose occupies one-third of the vertical dimension.

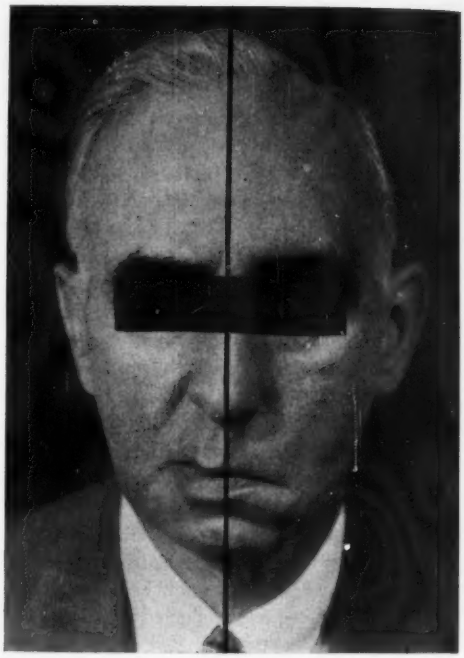


FIG. 2. Note the elongation, flabbiness, and banging jowls of this patient's left cheek (Bell's Palsy). Note the difference of the face. The patient's left or elongated side seems older than his right side. Age 51.

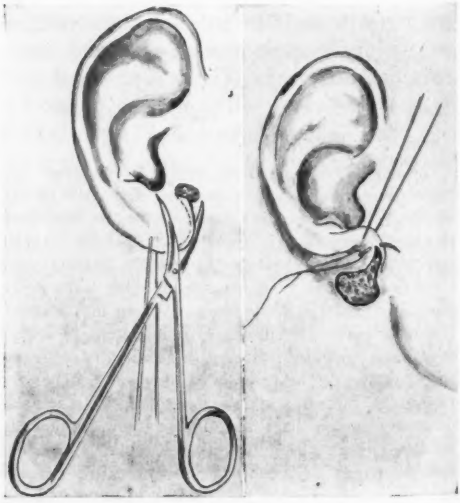


FIGURE 3. FIGURE 4

FIG. 3. Slightly triangular wedge excised from ear lobule.

FIG. 4. Closure of wedge of ear lobule with interrupted sutures.

FIG. 5. Outline of a typical incision for facial rejuvenation operation and a schematic lineament of the skin excision.

FIG. 7. Suture line hidden within the hair edge, shown here with a dotted line, and behind the ear lobe.

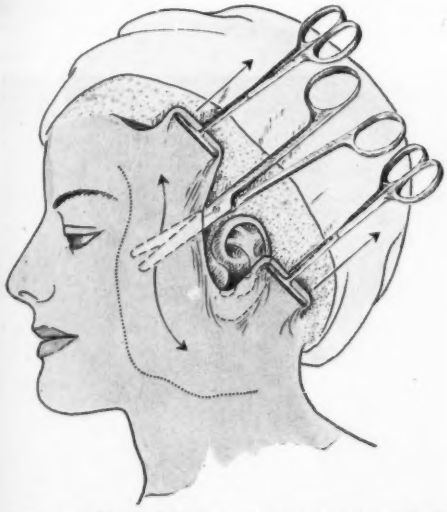


FIG. 6. Undercutting of the facial skin and the rotation of the cheek and neck integument posteriorly and superiorly.

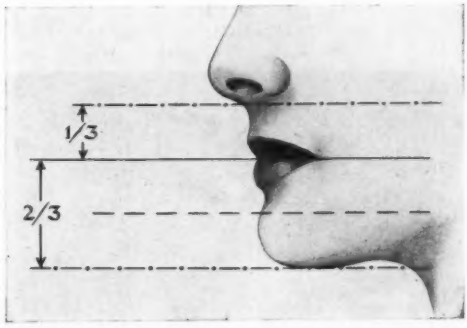


FIG. 8. Subdivision of the lower third of the face, one-third above the lip line and two-thirds below the lip line in individuals with normal vertical dimension.

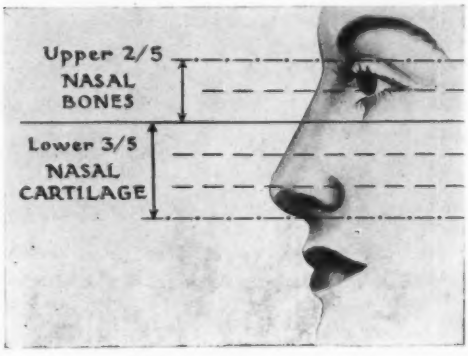


FIG. 9. Divisions of the nose into its nasal and cartilaginous components.

FIG. 10a. Profile of a typical premature facial senescence. Age given as 55.

FIG. 10b. Corrected with elimination of redundant facial skin and reduction of vertical dimension of the nose.

FIG. 10c. Front view of same patient before surgery.

FIG. 10d. Front view of the same patient after surgery.

FIG. 11a. Premature facial senescence. Note the over-hanging upper eyelids, the creases about the mouth and the beginning evidence of hanging jowls. Age 36.

FIG. 11b. Rejuvenation by elimination of redundant facial skin and correction of baggy upper eyelids and dental prosthetic work to correct the bulging anterior teeth. Judicious makeup.

FIG. 12a. Pendulous cheeks and hanging jowls. Note how they increase apparent age. Age 47.

FIG. 12b. Note increase in youthfulness after a face lift operation.

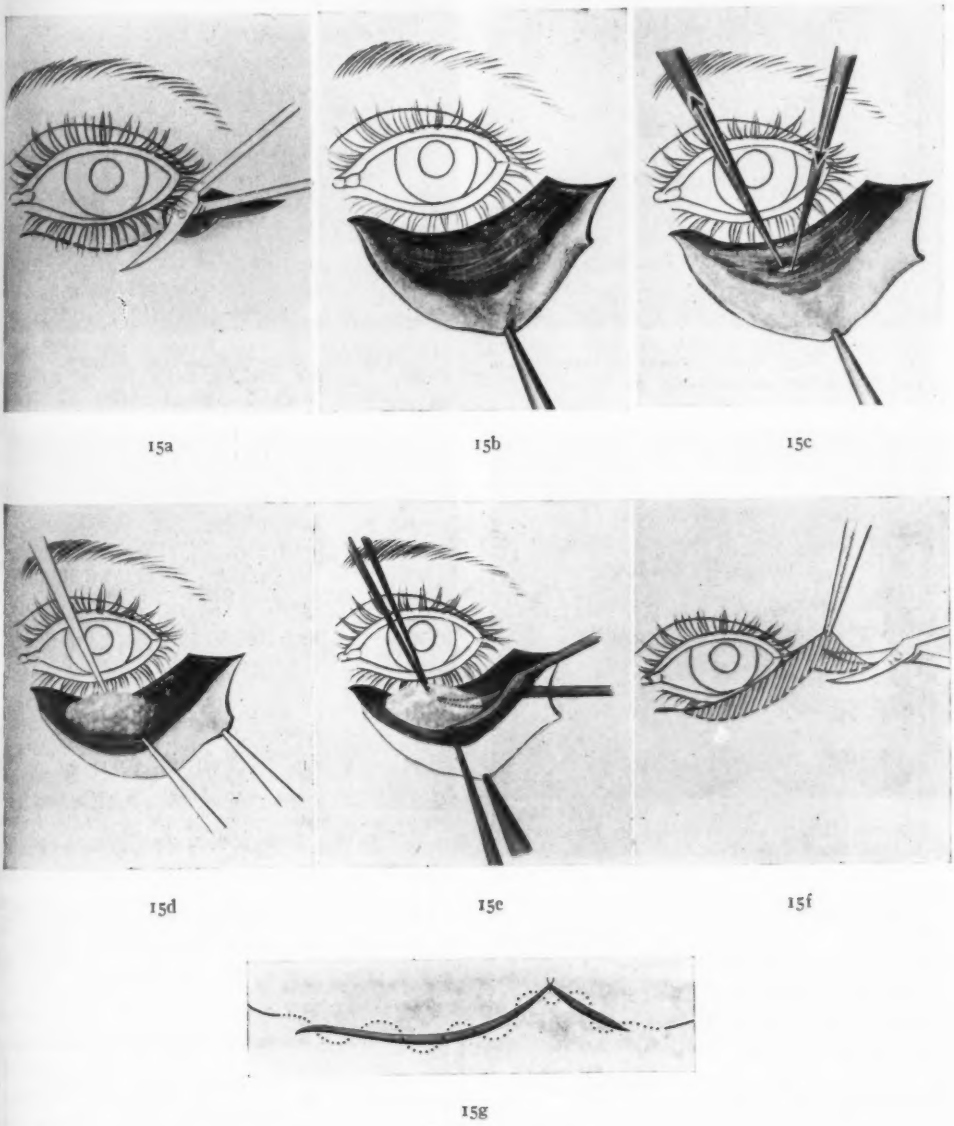
FIG. 13a. Profile showing that an elongated nose creates the appearance of age. Age 42.

FIG. 13b. Shortening of the vertical dimension of the nose by rhinoplastic operation not only brings out beauty in the face but also increases apparent youthfulness of the profile.

FIGURE 14a.

FIG. 14. Illustrating the rejuvenating effect of shortening the nasal vertical dimension. A. Before, B. After. Age 58.

FIGURE 14b.



15a 15b 15c

15d 15e 15f

15g

FIG. 15a-15g. Surgical procedure for removal of bagginess of eyelids.

FIG. 16a. Baggy eyelids caused by herniation of orbital fat—Before surgery—Age 39.

FIG. 16b. Same patient after surgery.

FIG. 16c. Baggy eyelids caused by herniation of orbital fat—Before surgery—Age 36.

FIG. 16d. Same patient after surgery.

Psycho-somatic troubles are recognized entities today. The face lift and other rejuvenation operations should no longer be regarded as the stepchildren of plastic surgery. These surgeon-created facial improvements may be called somato-psychic operations, for they do, by artistic somatic change, produce psychic change that is desirable.

SUMMARY

A survey is given of the artistic anatomy of the youthful and aged face, and the surgical indications and techniques of face lifting, nose shortening, and removal of bagginess of eyelids for restoring the youthful appearance to premature facial senility are described.

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Aging in Air Force Pilots

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AIR Force pilots reach "old age retirement" when they are relatively young. This is emphasized by the following news note of April 19, 1952, with Tokyo dateline. It reads: "The oldest combat aircraft commander in the U. S. Air Force is going home. He is 43, a B-29 pilot who has logged more than 800 hours of combat flying. He has amassed 106 combat missions, 39 in his 10 months with the Far East Air Force flying the reconnaissance version of the Superfort, the RB-29." Obviously, we have here a capable pilot retired at 43, two decades earlier than might have occurred in some other branches of military service.

Planned interviews were conducted on 851 aircrewmen at bases in continental United States and in Hawaii, Korea, and Japan. The research procedure followed was that of the Critical Incident Technique which has been developed at the American Institute for Research and found useful as a method of studying several other problems prior to undertaking this one (1, 2, 3). The critical incident technique as used in this investigation involved the collection of reported behaviors of associates and acquaintances known for several years, and also self-behavior, under carefully specified and described circumstances, in which the reporter interviewee judged that the quality of performance was chiefly determined by the aging factor. The aircrewmen were requested to cite incidents in which the influence of aging was believed to have had a critical effect either leading to notably poorer or better performance (4, 5).

Before interviewing Air Force personnel in reference to aging, a comprehesive pre-test was conducted on 185 Pittsburgh firemen, printers, and other civilian groups, to discover a) the type of question which would elicit the most and the best critical incidents; b) the type of interview procedure which would provide the most data in the least time; and c) the optimal length of a questionnaire for group interview use. Institute research had answered these questions for other studies. It was believed that some difference might be injected into this research situation due to the new factor, namely, the requirement that the respondent make a judgment that the critical incidents were due to aging.

The results on the firemen indicated that the best type of question to use was one which directly asked for change in level of performance due to aging without specifying the physiologic or psychologic functions influenced. The results also showed that it was feasible to employ group interviewing (6 men at a time) in this area. Finally, it seemed that the questions should be phrased to elicit effective as well as ineffective incidents. While the primary concern of this research was the detection of impairment due to aging, the psychologic effect of asking only for signs of decline was found frequently to produce defensive or depressed attitudes, depending on the age of the interviewee.

There was also an Air Force pre-test involving two types of questionnaires, A, direct, and B, indirect. The former was administered to 100 interviewees and the latter to 91 interviewees. The results indicated the desirability of a shorter direct questionnaire. The third form (C) was developed, tested, found highly satisfactory, and used in the major portion of the survey.

In the third (C) questionnaire, items asked for incidents due to aging but placed greater emphasis upon the respondent as an expert source of information on aging in aircrewmen and less emphasis upon signs of aging in the

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respondent himself. He was first asked to state the signs of aging which he would look for if he were a member of a board evaluating the fitness of aircrew. Second, he was asked to cite an incident illustrating how one or more of these symptoms affected performance adversely. And third, he was asked for an illustration of a critical incident which was due to aging in the respondent and was ineffective as an on-the-job performance. For each of the critical incidents given as an illustration the respondent gave also the man's age, type of plane he was flying, his MOS (Military Occupational Specialty), and the number of flight hours' experience.

From the 851 subjects interviewed, a total of 1836 critical behaviors were recorded. These were classified under 5 main divisional areas: I, retention of physical abilities required for the job; II, learning and practicing skills of specialty; III, flight performance, a.) preparation and planning for the mission, b.) technical aspects, c.) tactics and operations in flight, d.) landing; IV, relations with co-workers; V, morale and adjustment with respect to job. Under each of these headings there were categories and sub-categories so that the total number of categories under which the behaviors were classified was 300.

The categories and sub-categories were developed inductively through study of the critical behaviors and thus resulted in a comprehensive system of relatively independent headings which covered all of the responses obtained. The effective behaviors collected through use of questionnaires A and B were included and generally fall in the classes parallel to those of the ineffective incidents. However, they give us a less detailed picture since only one-fifth as many effective responses were asked for as for ineffective. A total of 457 effective and 1379 ineffective critical behaviors were classified. The average age of the persons interviewed (table 1) was 29.5 years. The average for the reported age of the people involved in critical incidents was 31.2 years, and their flight experience averaged 2000 hours.

TABLE 1. FREQUENCY DISTRIBUTIONS OF THE AGES OF PERSONS INTERVIEWED AND OF PERSONS REPORTED ON IN RESPONSES*

Age	Persons Interviewed	Persons Reported on in Responses
20-24	58	43
25-29	323	447
30-34	343	617
35-39	50	187
40 and over	1	61
Mean**	29.5	31.2

*In some cases interviewees neglected to supply information on age.

**Computed from ungrouped data.

The aircrew population which supplied the reports of behaviors analyzed in this study represented a relatively narrow range of military occupational specialties as shown in table 2.

TABLE 2. DISTRIBUTION OF MILITARY OCCUPATIONAL SPECIALTIES OF PERSONS INTERVIEWED AND OF PERSONS REPORTED ON IN THE RESPONSES

Job Title	Number	
	Interviewed	Reported on in Responses
Pilots		
Four engine	136	294
Jet fighter	105	157
Single engine	87	171
Two engine	66	121
All-weather fighter	26	42
Navigator-bombardier	14	12
Six engines or more	7	13
Strategic reconnaissance	5	7
Tactical reconnaissance	4	5
Multi-engine amphibian	2	3
Radio controlled target	-	1
Other Rated Personnel		
Navigator	86	125
Navigator-bombardier	55	79
Bombardier	51	56
Radar observer		
all-weather fighter	38	60
bombardment	24	26
Operations officer	16	25
Flight engineer	2	9
Other Combat and Operations Personnel*	23	39

*These persons must also have had ratings as aircrew members, but reported only their primary occupations.

About 62 per cent of those who supplied accounts of critical incidents were pilots and 38 per cent were navigators, bombardiers, or other

crew members. The aircrewmen reported upon in 68 per cent of the cases were pilots and in about 32 per cent of instances were navigators, bombardiers, or other flight specialists.

As samples of ineffective critical incidents the following 5 reported behaviors are cited and in each case the person's age, flight time, and military occupational specialty are given:

1. "The pilot of a B-29, while flying at night and on instruments, let the attitude of the ship change to nose high and the airspeed fall to near stalling, without noticing it. The other pilot noticed it and brought the ship back to normal in time. The first pilot was not alert enough to catch the change." Age: 32, Flight Time: 2000 hours, MOS: Pilot, four engine.

2. "An older pilot used poor and outdated procedures. He is a good pilot but dangerous to other aircraft in the air, because of these improper procedures. He suffers from 'uneagerness' and doesn't keep up with the latest procedures. He has that 'things aren't like in the old days' attitude." Age: 38, Flight Time: 3000, MOS: Pilot, two engine.

3. "A pilot who was on a cross-country navigation mission got off course about 50 miles and had to land at a base other than the intended one; he had not planned his course on the ground, and did a poor job of tracking. The weather was clear, so it should have been an easy flight. He considered the flight so simple that planning was unnecessary — he has become quite lax." Age: 26, Flight Time: 1500, MOS: Jet fighter pilot.

4. "I had an opportunity for a two-month period to fly a number of different types of planes and get varied experience. When I was younger I would have been checked out in all of the different aircraft in two weeks, but this time I didn't care to try. I figured — what would it get me?" Age: 27, Flight Time: 1300 hours, MOS: Pilot, two engine.

5. "We were flying a typhoon reconnaissance mission, and I'd had no sleep in 24 hours. When I was younger I flew often without sufficient rest without ill effect but this time I discovered that I had been reading my watch as an altimeter and entering altitude in the time column of my log. I would have said that this was impossible." Age: 35, Flight Time: 2000 hours, MOS: Navigator.

The numbers and percentages of effective and ineffective CI's falling in the major areas of classification are shown in table 3. The columns representing percentages of incidents give the best general outline view of where age gets in its effects on aircrewmen according to the observations and opinions of aircrewmen themselves. More than 40 per cent of all the ineffective behaviors reported concern changes in physical abilities required for the job. An illustration here is unfavorable reactions to 'g" forces which showed 40 ineffective instances, 2.9 per cent, mean age 30 yrs., $\sigma = 3.9$ yrs. Under the category of "deterioration of visual-perceptual ability" there were 44 instances, 3.2 per cent, mean age 33 yrs., $\sigma = 8.0$.

By far the most frequent type of change reported to occur with age is "increased susceptibility to fatigue." Such change accounts for 27.5 per cent of the ineffective CI's reported (379 of 1379 cases), mean age 31, $\sigma = 3.8$, mean flying hours 2300. The concept of fatigue is not a simple one and it is certainly not a purely physiologic reaction, since motivational and situational factors have an influence.

Other less frequent changes with age are: $IIIC_2$, "Proficiency under stress," 115 ineffective, 8.3 per cent, mean age 33, $\sigma = 5.2$, flying hours 2200; 56 effective, mean age 31, $\sigma = 5.9$; V_1, "Motivation with respect to job," 90 ineffective, 6.5 per cent, mean age 31, $\sigma = 4.0$; 5 effective, mean age 29, $\sigma = 2.1$; V_2, "Has 'specific' or generalized fear related to job," 134 ineffective, 9.7 per cent, mean age 31, $\sigma = 4.9$; 36 effective, mean age 29, $\sigma = 3.6$; IIID, "Makes poorer landings," 87 ineffective, 6.3 per cent, mean age 34, $\sigma = 6.5$, flying hours 3400; 9 effective, mean age 28, $\sigma = 3.3$; II_1, "Lack of interest in improving skill and knowledge of job," 49 ineffective, 3.5 per cent, mean age 35, $\sigma = 7.2$, flying hours 2500; effective, "Tries to improve his job performance," 76 cases, mean age 28, $\sigma = 2.5$. All other sub-categories showed less than 3

TABLE 3. DISTRIBUTION OF BEHAVIORS AND PERCENTAGES OF EFFECTIVE AND INEFFECTIVE BEHAVIORS FALLING IN THE MAJOR AREAS OF CLASSIFICATION

Area of Classification	Ineffective		Effective	
	Frequency of Behaviors	Percentage of Total Ineffective	Frequency of Behaviors	Percentage of Total Effective
I. Retention of Physical Abilities Required for the Job	572	41.5	---	----
II. Learning and Practicing Skills of Specialty	70	5.1	102	22.4
III. Flight Performance:				
A. preparation and planning for the mission	39	2.8	134	29.4
B. technical aspects	139	10.1	69	15.1
C. tactics and operations in flight	164	11.9	78	17.1
D. landings	87	6.3	9	2.0
Sub-totals	429	31.1	290	63.6
IV. Relations with Co-workers	44	3.2	7	1.5
V. Morale and Adjustment with Respect to Job	264	19.2	57	12.5
Total	1379	100.1	457	100.0

per cent of the reported 1379 ineffective CI's.

From the data we may hypothesize that subsequent to completion of the training courses given our military aviators, their flying skills and competence usually continue to improve for a period of several years. There comes a leveling off time and later some deterioration in various phases of their professional work. The present investigation indicates that experience probably compensates for minor deficiences caused by physical aging in the mid-twenties and in addition leads to an increase in skill. A peak seems to be reached, however, after which performance deteriorates, which we may hypothesize to be due to the fact that physical and motivational changes begin to outweigh the positive effects of experience. Such a thesis is supported by the fairly consistent differences in the mean chronologic ages of persons showing effective behaviors and those showing ineffective behaviors within the same categories which deal with job performance. Examples of this definite trend are shown in the paragraph above.

The findings on morale and motivational changes, indicated in area V, would seem to have great significance. These changes not only influence effective performance but are probably in part caused by the ineffective performance (6). A self-appraisal of inability to perform effectively in a well-learned skill may generate a decrement in adjustment to the job. In each of the sub-categories in the area of morale and adjustment, the age differences, although in the expected direction, seem relatively small. A general type of ineffective attitude which develops, according to our results, with aging and increased flying hours, is the loss of interest in and satisfactions derived from the job. It is difficult to estimate what

proportion of this loss of interest and motivation may be due to fear responses related to military operations.

As indicated in table 2, which shows the distribution of military occupational specialities for the personnel reported upon, it is possible to compare fighter pilots with bomber pilots from the data that were gathered. The remaining aircrewmen constitute a comparison group designated "other." Ineffective critical incidents reclassified on this basis gave: Fighter Pilots 368, Bomber Pilots 403, Other 581. The total number of CI's classified in this way, 1352 ineffective CI's, may be considered representative of the 1352 ineffective CI's collected in this project. For the sub-category, "Suffers from greater fatigue," Fighter Pilots show 73 CI's = 19.8 per cent, and Bomber Pilots 114 CI's = 28.2 per cent.

For the entire major Category I, "Changes in Physical Abilities Required for the Jobs," Fighter Pilots show 125 CI's = 33.8 per cent, and Bomber Pilots 168 CI's = 41.5 per cent, and this difference is significant at the .05 level of confidence. Bomber pilots 8 times as frequently as fighter pilots in this study show ineffective relations with coworkers (Category IV), and this difference is significant at the .01 level of confidence. Fighter pilots show 13 times as many effective CI's as bomber pilots in III-A, Flight Performance, Preparation, and this is significant at the .01 level of confidence. It seems quite important to note that in the total count of effective CI's the bomber group have 60 while the fighter pilots are credited with 253 and the "Other" group with 119.

Another regrouping of the data of this study by evaluations of two independent judges developed two wide categories: 1) change in motivation toward one's job, and 2) resistance to fear in connection with the job. There were 341 ineffective and 255 effective behaviors classified in the motivation category, and 262 ineffective as against 93 effective CI's in the fear grouping.

Cross-tabulations of these data by age and hours of flight experience were prepared (2). A chi-square of 90.16 (significant at the .001 level) was found for age and the motivation category, i. e., there appears a significant increase in ineffective motivation and decrease in effective motivation with age. Similarly for the fear category, CI's representing development of fear increased with age and those showing more effective resistance to fear decreased in the older pilots. The chi-square here approached the .02 level of confidence. Computed biserial correlations show –.54 for motivation and –.20 for fear in relation to age. Hours of flight and effective motivation also indicated a moderately high negative relationship, –.45.

As should be expected, the relationship between age and flight hours of experience is fairly high expressed in Pearson product-moment correlation coefficients. For the categories of motivation and fear under consideration the coefficients are .50 and .46 respectively. A measure of the relative importance of chronologic age in comparison with flight hours of experience with respect to effectiveness of motivation for on the job performance is reflected in partial correlation coefficients. The correlation between age and effective motivation, holding experience constant, here proved to be –.41; between experience and effective motivation, holding age constant, showed –.24. Partial correlations for the fear category were not made because of the low biserial coefficient, –.10, between experience and effective resistance to fear.

The relationship of chronologic age and types of motivation leading to ineffective flying performance seems definite and substantial. But the same cannot be said for the psychologic area of fear of flying. It is not clear from this study what variable or variables other than chronologic age build up fear behaviors in aircrewmen.

Summary

1. An investigation of aging in Air Force pilots, conducted by personnel in the American Institute for Research (Pittsburgh), under contract with the School

of Aviation Medicine of the U. S. Air Force, was accomplished by use of the critical incident technique.

2. Comprehensive pre-tests were made on 185 Pittsburgh firemen, printers, and other civilian groups to discover the types of question and interview method that would elicit the most and best cirtical incidents due to aging.
3. Through interviewing 851 aircrewmen in continental United States and abroad a total of 1836 critical behaviors believed to be due to aging were recorded. These incidents were classified according to psychologic categories.
4. The average age of the crewmen interviewed was 29.5 yrs. and of those reported upon was 31.2 years.
5. Of those who supplied critical incidents 62 per cent were pilots and 38 per cent were navigators, bombardiers, or other aircrewmen; 68 per cent of the CI's reported concerned pilots, 32 per cent were about other personnel in flight crews.
6. Samples of both ineffective and effective CI's representing changes in proficiency due to aging are given in the report together with a tabulation of the number and percentage of reported critical behaviors occurring under different categories.
7. More than 40 per cent of all ineffective behaviors reported concern changes in physical abilities and 27.5 per cent of this group were recorded under "increased susceptibility to fatigue," mean age 31, $\sigma = 3.8$, mean flying hours 2300.
8. Under the category, "motivation with respect to job," there were 90 ineffective cases, mean age 31, $\sigma = 4.0$, and 5 effective, mean age 29, $\sigma = 2.1$ years.
9. Decreased motivation toward military flying and age in years gave a biserial correlation of −.54.
10. Hours of flight experience and effective motivation showed a negative relationship, −.45.
11. The results of this study represent something of a check list for use by those whose responsibility lies in observing and evaluating the fitness of military aircrew personnel.

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The research results reported in this paper are an abbreviated account of the outcomes from a contract given by the Department of Experimental Psychology, School of Aviation Medicine of the U. S. Air Force to the American Institute for Research, of which Dr. John C. Flanagan is President and Director. The Project Director for this specific contract was Dr. Beatrice M. Shriver, and the other author served as research adviser.

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Differential Mental Deterioration of Factorially "Pure" Functions in Later Maturity

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THE purpose of this article is to present the results of a pilot study in which the Thurstone Primary Mental Abilities test battery (16) was given to a group of 61 subjects between the ages of 53 and 78, with a view to studying rates and types of differential decline in factorially pure functions. The mental abilities considered are: verbal meaning, space, reasoning, number, and word fluency. The present study also supplies data on the relationship between speed and power in the performance of older subjects.

A survey of the literature on the problem of mental decline as a function of the aging process seems to indicate that comparatively little work has been done toward assaying the types and rates of decline of distinguishable mental abilities during later maturity (2). Perhaps this is because we do not have tests of reasonable factorial purity specifically designed for this age group. Lacking such tests, the Thurstone Primary Mental Abilities battery designed for a younger group was used.[1]

Review of Previous Studies

In one of the earliest studies in this field, Gilbert (5) tried to show differential deterioration by giving separate curves for the various sub-tests of the revised Babcock battery, which she used to compare two groups, one 20 to 29 years old, and the other 60 to 69. This test, however, seems aimed at a global survey of intelligence as a definite faculty, and hence, does not allow definitive conclusions on the relative function of the various abilities in her curve of decline.

Jones and Conrad (9), who used the Army Alpha test in a study of changing mental ability with a group aged from 10 to 60, were also faced with the problem of determining the actual meaning of their sub-tests, as applied to the differential decline of distinct abilities.

Much valuable evidence in regard to differential decline with age is offered in Wechsler's classical studies (21, 22). However, complete data and norms are provided only up to age 59, the approximate point at which the steep drop and rapid decline in the intelligence curve is often placed (1). Also, since the sub-tests of the Wechsler-Bellevue series do not possess a reasonable degree of factorial purity, it is often difficult to see what the psychologic functions measured actually are.

The results of the present investigation substantiate some of the findings of various authors in regard to their lists of abilities which in their respective studies were shown to hold up longest, and others which deteriorated earlier (4, 5, 7, 9, 11, 13, 22). The purpose of the present investigation, however, was primarily to see whether a more identifiable pattern of decline might be shown when a highly diagnostic and factorially pure test would be employed. The basis for a working hypothesis of mental deterioration of distinguishable abilities, based on more refined criteria might thus be established.

Description of the Test Battery

Thurstone's Science Research Associates Primary Mental Abilities Test (Intermediate Form) seemed to be the best, although by no means ideal, instrument for the purpose of our study. The test battery consists of 5 sub-tests designed to cover the independent factors listed

[1] It is recognized that factorial "purity" for a population of adolescents does not guarantee "purity" for a mature group. However our test intercorrelations indicated that the abilities tested were, in fact, relatively independent (table 2).

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below with the descriptions as furnished in the test manual (18):

1. *Verbal-meaning* (V) is the ability to understand ideas expressed in words.
2. *Space* (S) is the ability to think about objects in two or three dimensions.
3. *Reasoning* (R) is the ability to solve logical problems—to foresee and plan. This is a composite measure of *inductive* reasoning and *deductive* reasoning.
4. *Number* (N) is the ability to work with figures —to handle simple quantitative problems rapidly and accurately.
5. *Word-fluency* (W) is the ability to write and talk easily.

The battery was derived by the factor-analysis (17) of about 60 mental tests, resulting in the isolation of the several distinguishable abilities just described. A test was then constructed to measure each of these abilities, the relative independence of the tests included in the final battery being demonstrated by their low intercorrelations (15).

Since the test was originally constructed for the testing of a high-school age population, it was believed that we could not, for our purposes, be satisfied with the high reliability and low intercorrelation figures claimed for the test by its authors (18). The results of our own reliability and intercorrelation studies will later be discussed in detail.

Experimental Procedure

The test was administered to groups of 4 or 5 subjects at a time; both as a speeded test, that is, with the time limits prescribed in Thurstone and Thurstone's *Examiner's Manual* (18), and then the subjects were allowed to finish the test on their own time to obtain a second set of scores, thus using the battery as a power test. As we were measuring the performance of older people who might be expected to work more slowly we were thus enabled to compare performance under two sets of conditions, and also to obtain an estimate of what may be expected when the speed factor is eliminated.

The 61 subjects for this study were obtained from various senior recreation centers and from patients of the Institute of Endocrinology and Gerontology in San Francisco and were unselected in respect to education, ethnic, and economic background. The sample contained 25 subjects with grammar school education, 24 subjects with high school education, and 12 subjects who had attended college. By occupation, they were classified as: professional, 6; clerical, 20; sales, 5; skilled, 11; unskilled, 5; and housewives, 14.

The subjects used were physically comparable to individuals in similar groups of the general population. No subjects with obvious abnormalities of hearing or vision, which might be expected to influence the results, were included.

The sample of 61 cases was arbitrarily divided into 4 age-groups, containing 16, 17, 16, and 12 subjects, respectively. These age-groups were: Years, 53 to 58, 59 to 64, 65 to 70, and 71 to 78. These groups will be referred to respectively as Groups I, II, III, and IV.

The raw test scores were converted into percentile scores using Thurstone's conversion table for his 17-year old standardization group (18). This was done to make possible comparisons between abilities as well as age groups.

Results

Consultation of the graph for the speed test for the whole group (fig. 1) will show that the

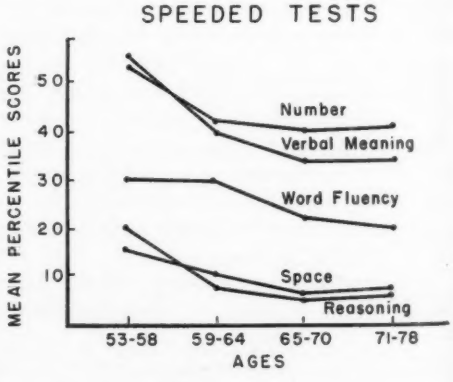

Fig. 1

steepest decline compared with younger individuals was found for the Reasoning and Space abilities. The mean percentile scores, as compared with the 17-year old population of the standardization sample, ranged from 15.81 to 7.56 for groups I and IV, respectively, for Space; and from 21.63 to 6.58 for Reasoning. The least changes were found to occur for Number, Word-fluency, and Verbal-meaning in the order given. Mean percentile scores for these abilities for group I and IV, respectively, were: Number, 53.12 to 41.25; Word-fluency, 30.38 to 20.58; Verbal-meaning, 55.19 to 36.83. A complete summary of means and standard deviations of our sub-groups will be found in table 1.

Discussion

These findings confirm the results of previous studies (3, 6) using less refined tests, and could be due to numerous causes among which the practice factor would seem prominent (14). Abilities dealing with words and numbers, being used constantly throughout the individual's life span, would tend to hold up better than those subject to disuse. This trend, would, of course, be modified by such factors as education and occupation, which we attempted to randomize in this study.

It can be assumed that the reaction time of an aging person will slow down (12). The lower scores might therefore, be explained as a function of this slowing-down process. To eliminate the speed factor, the performance of our group is compared with results obtained when no time limits were imposed upon the subjects (table 1). A scrutiny of fig. 2 will show that in general, all scores in the power test are higher than those obtained from the speeded test; however, a faster decline within our group of individuals seems evident in the power test. It may be that, as a result of the

TABLE 1. MEANS AND STANDARD DEVIATIONS OF SUB-GROUPS*

Group	Age (years)	N	Speeded Test: N = 61									
			Verbal Meaning		Space		Reasoning		Number		Word Fluency	
			Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.
I	53-58	16	55.19	28.7	15.81	19.1	21.63	20.3	53.12	37.3	30.38	27.5
II	59-64	17	39.59	27.0	10.24	11.3	8.94	10.2	42.41	30.0	30.24	39.6
III	65-70	16	35.31	22.3	7.00	9.4	5.81	10.4	40.88	35.8	22.38	20.5
IV	71-78	12	36.83	34.1	7.56	9.2	6.58	8.4	41.25	33.4	20.58	11.4
			Power Test: N = 31									
I	53-58	7	92.57	5.2	60.14	40.5	76.14	20.6	98.00	2.0		
II	59-64	10	65.50	30.5	38.30	36.1	20.09	27.4	91.63	19.5		
III	65-70	8	81.12	14.0	23.00	35.4	5.00	6.2	97.00	2.4		
IV	71-78	6	80.17	16.1	46.50	33.1	19.33	19.3	85.80	17.6		

* All scores are percentile scores converted from the raw scores by the use of Thurstone's conversion table for his 17-year old standardization group (18).

lower scores earned in the speeded test, the curve can simply not assume such a steep drop because of the limits imposed by the fact that a score of zero is the lowest attainable. Nevertheless, it is demonstrated that there is a differential decline regardless of the speed factor, with the abilities of Reasoning, and probably also Space, dropping at much faster rates than the abilities of Verbal-meaning and Number.

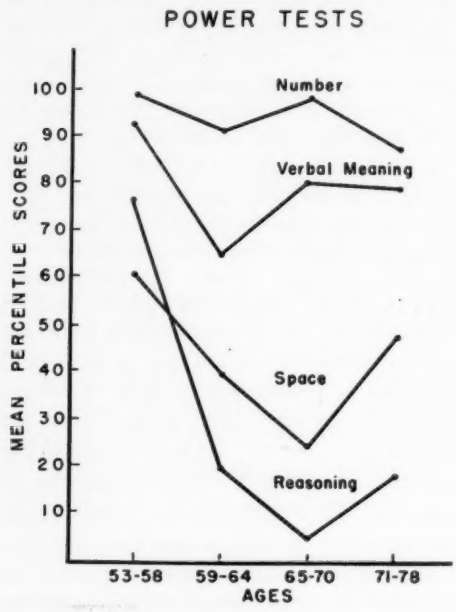

FIG. 2

Imposing time limits seems to introduce an artifact into the results by lowering *all* the scores to such a degree that the actual decline cannot always be effectively demonstrated. A statistical analysis of the significance of the difference between the means of Groups I and III (53 to 58 and 65 to 70, respectively) give significant differences at the 5 per cent level, or better, for all factors, while figures of such magnitude can be reported for the speeded test only for the factors of Reasoning and Verbal-meaning.

The leveling off of the curves of decline from Group III to Group IV is worthy of note (see figs.). It may be speculated that such leveling off is an effect of the elimination of the less fit. Further investigation of this aspect seems indicated.

TABLE 2. INTERCORRELATIONS OF PRIMARY MENTAL FACTORS AS OBTAINED IN THIS STUDY COMPARED WITH THE INTERCORRELATIONS REPORTED IN THE S. R. A. MANUAL AND IN THE TOWNSEND STUDY

Variables	Present Study	S. R. A. Manual (18)	Townsend Study (19)
Verbal - Space	.108	.18	.19
Verbal - Reasoning	.160	.33	.49
Verbal - Number	.106	.17	.26
Verbal - Word-fluency	.245	.29	.37
Space - Reasoning	.307	.24	.33
Space - Number	.069	.10	.13
Space - Word-fluency	.064	.12	.18
Reasoning - Number	.212	.21	.41
Reasoning - Word-fluency	.151	.27	.27
Number - Word-fluency	.092	.25	.38

Intercorrelations and Reliabilities

The intercorrelation study supplies data which seem to support our assumption that we are actually measuring independent abilities. The obtained correlations range from .064 between Space and Verbal-meaning to .307 between Space and Reasoning. No intercorrelation reaches a significance figure of better than chance at the 1 per cent confidence level (10). It is interesting to note that the intercorrelations which we obtained are substantially lower than those given by Thurstone and for other studies of the Primary Mental Abilities batteries (8) when younger subjects were used. This could indicate that the test is, perhaps, a more accurate instrument with an older age group. It is possible, however, that this impression might be erroneous, due to the difference in variability between the different populations tested. Tables 2 and 3 include the

TABLE 3. VARIABILITY OF THE SAMPLE GROUPS

Variables	Standard Deviation	
	Present Study N = 61	Townsend Study (19) N = 100
Verbal-meaning	27.46	12.65
Space	13.71	21.17
Reasoning	15.13	8.35
Number	34.64	17.76
Word-fluency	27.89	*

*No comparable figure is given in the Townsend report for the Word-fluency test.

intercorrelation figures and group variances compared with those obtained in the Townsend Study (19).

Reliability coefficients were computed by the split-half method, corrected by the Spearman-Brown formula, and found to be reassuringly high, ranging from .92 for Space to .96 for Number (table 4). These figures were obtained from the power-test scores only, thus are *not* spuriously high due to the influence of speed (20).

Summary

This paper presented results of a pilot study intended to demonstrate differential decline of factorially pure mental abilities in later maturity.

The Thurstone Primary Mental Abilities battery measuring Verbal-meaning, Space, Reasoning, Number, and Word-fluency abilities were given to subjects aged 53 to 78, both as a speeded and as a power test.

Space and Reasoning abilities were found to decline much faster than Number, Verbal-meaning, and Word-fluency, when the time limit, which imposes an additional handicap on older people, is removed.

Although designed for a much younger group, the test used seemed both valid and reliable for the sample tested; also the relative independence of the separate abilities seemed corroborated.

TABLE 4. RELIABILITY COEFFICIENTS (N = 31)

Variables	r_{11}	Index of Reliability
Verbal-meaning	.947	.973
Reasoning	.943	.971
Space	.921	.960
Number	.957	.978

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Family Relations in Middle and Old Age
A Review

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THIS paper is an attempt to investigate the need for research in family relations in middle and old age. Much has been written about the family in the United States concerning the problems of courtship, marriage, and marital adjustment (2). This emphasis on the early stages of the family life cycle has been accompanied by exhaustive research on the personality development of the child but has resulted in a neglect of studies in the later stages of family life (9). More recently, old age has become an area of interest to researchers (6).

To date, research on the family has been concerned with the extremes of the family life cycle. Thus middle age has been a neglected phase of family life. However, there have been descriptions of the family life cycle which characterize middle age as the stage at which the children leave home (14), or as the period of the "empty nest" (7). Our knowledge of the family in this stage has not noticeably increased since Waller (28) wrote in 1938 ". . . information concerning the fifth stage [the stage of the empty nest] was found to be so scant as to necessitate omitting discussion of that stage altogether."

After a detailed analysis of references to old age in twenty texts, Beard (1) concludes that older people are excluded or given little attention in college texts on the sociology of the family. The increasing proportion of older people in the population has brought into focus the necessity for research on middle age as a contributing factor in the understanding of old age (16, 26). Measures to help the aging are most fruitful, it has been claimed, when applied during middle maturity, but research on middle maturity must precede any well conceived preventive programs (18). Moreover, since many of the problems of children originate in the problems of their parents, a knowledge of the problems of middle-aged parents would indicate the kinds of pressures to which children and grandchildren are likely to be subjected (20).

Furthermore, the decline in family size and the increased likelihood of longer life expectancy have made it probable that parents will live together one-fourth of their entire married life, more than a decade, after the children leave home (14). The conjugal family system in the United States thus increases the necessity for knowledge of parental adjustments during middle age (23).

However, the problem is complicated by the absence of any clear-cut definition of middle age. Should a definition of middle age be chronologic or functional, should it be general or specific, or should it be defined as unitary or as degree of age? (25). Chronologic, physiologic, psychologic, or sociologic criteria of age do not yield a convenient classification which may be labeled "middle age" (6, 27). These factors may, however, be combined to form an age-culture pattern definition of middle age as shown by Cavan and associates (6).

Thus middle age—the time when children leave home, maximum earnings have probably been reached, and retirement is not too far distant—seems to be a time in which family relationships change. The children are no longer at home, the hopes and aspirations of "success" have probably faded away, and a decline in physiologic energy becomes more pronounced—in short, the behavior patterns developed since marriage must somehow change to cope with new conditions. The findings of major research concerning what happens to the family, particularly the parents, during later maturity constitutes the major portion of this paper. Finally, a summary of theories concerning this period are reported.

The later stages of family life as a field of study have attracted attention only recently and as a result little has been done to study family adjustments during these stages.

Cavan (3) declares that "Research projects or even well considered statements of opinion on intra-family relationships involving old persons are very few in number and limited in scope." According to her, the material available falls into two classes, statements of opinion, and empiric research projects. In the latter category a body of verifiable generalizations is beginning to emerge. A survey of the first category, however, does not reveal any substantial consensus.

Cavan's own works illustrate the conflicting opinions concerning middle age. In her text, *The Family* (4), she discusses the difficult adjustments which the mother must face and the relatively painless ones which confront the father. In the same chapter she presents the possibilities of "a placid and companionable" middle age as well as one in which husband and wife accentuate each other's fears. In a more recent volume Cavan states that middle age is hypothetically a relatively stable period (6). Further on in the same volume middle age is described as a transitional period of conflicting cultural traits.

Levy and Munroe (21) call the period of relinquishment a "second birth," an experience as painful psychologically as the original birth was physically. Christensen (7), however, describes a peaceful picture of this period when parents can rebuild some of the behavior patterns that existed before the children came and can draw closer together in companionship.

Gruenberg (15) calls middle age an especially difficult period for the entire family. She says, "New demands, new problems, new pressures, and new challenges test the resourcefulness and the flexibility of the parents. . . when they are least capable of making changes." Lewis (22) asserts that along with decreased physical strength and activity there appears a depressive mental attitude and an increasing difficulty in dealing with the ordinary problems of life.

Deutsch (8) gives a psychoanalytic interpretation of the problems of the middle-aged woman. The chief problem of the mother in middle age is, according to her, the breaking of the unity (identification) which exists between mother and child. This break is referred to as "the cutting of the psychic umbilical cord." The child constantly strives for the breaking of the tie, the mother for its preservation. Since the breaking of this tie is likely to be a traumatic experience, Deutsch maintains that only under the most favorable circumstances can the mother escape neurotic difficulties.

Deutsch's study does not provide us with psychologic or sociologic concomitants which would enable comparison with data obtained in subsequent research (17). It does, however, suggest that the actual break between parents and children when the latter leave home is a traumatic experience sufficient to cause a measurable change in the adjustment of the parents.

Difficulties in adjusting to the departure of the children may, as Burgess and Locke (2) suggest, occur: "1) where the parent is overly protective and possessive; 2) where the parent, lacking outside interests centers his hope, ambitions, and life around the child; 3) where the mate selected by the child diverges in personality characteristics, status, or values from parental expectations; 4) where the child is the partial or sole support of the parent, especially when the latter expects its continuance." Here again the problems of middle age as related to parent-child relations are not limited to the period of later life but reflect the pattern of relationships existing while the children were growing up.

Fried and Stern (12) in their study of the middle-aged and aged in the family in Montreal attempted to select a representative sample according to socio-economic status, sex, and age. The chief object of the study was to understand the circumstances with which older persons must cope, their ways of meeting these circumstances, and the mechanisms developed to gain satisfaction.

Two patterns of change were observed, decline in adjustment, and increase in adjustment. A decline in marital satisfaction was characterized by an increased selfishness and untidiness. In most cases where the spouses had few common interests at marriage they have grown further apart with advancing age. Some husbands and wives are held together primarily by habit or necessity for sharing living accommodations. In these cases departure of the children from the parental home increases the isolation of the parents because their chief common interest, the rearing of children, no longer exists and the parents now have more time for reflection on their marital relationship.

An increase in marital adjustment accompanies progressive assimilation of interest and habits with advancing age. Enforced retirement and serious illness modify the marital relationship in a manner satisfactory to the afflicted and frequently gratifying to the protecting partner. The afflicted one is gratified by the affection and increased protection whereas the other enjoys the feeling of usefulness. The subjects described themselves as being less demanding, less temperamental, and less bent on having their own way. The process of assimilation seemed to be accelerated by the maturation and departure of the children.

Although over two-thirds of the involutional group still have sexual intercourse, there has been a change in quality and frequency. Intercourse occurs less frequently and the males' preorgastic phase is longer. The diminished demands of the husbands have tended to increase satisfaction in some marriages. Those women who never or hardly ever achieved orgasm welcomed the termination of sex relations.

A minority of parents rely heavily on their grown children for emotional satisfaction. For some parents there is an excessive wish to be protected and for others there is an excessive wish to protect their children. Such parents usually are unhappy with their mates or their immediate environment. Women more frequently than men display this dependence on their children. Parents aged 50 to 64 have not yet weaned themselves from their children.

However, parents do not want to be economically dependent on their children, neither do they want to live with them.

From this study Fried and Stern conclude that most marriages which were satisfcatory at the time of the interview had always been good, but half of these improved as the couple aged. Unsatisfactory marriages had been more or less unsatisfactory from the beginning, and approximately half of these deteriorated further with advancing age. Departure of the children sometimes tends to be a precipitating factor in marital discord and at other times it permits the parents to draw closer together. Increased eco-

nomic security in later life is associated with satisfactory human relations and happier home lives.

By analyzing data from the case histories of 26 men and 39 women between 50 and 80 years of age, Fried (11) attempted to study the hopes, fears, and inner conflicts of older people. In her sample there were 39 persons in the involutional phase (50 to 64 years) and 36 persons in the post-involutional phase (65 to 80 years). Detailed interviews yielded data on the actual extent of activities, and on attempts made to adapt activities to psychophysical condition and retirement. She found that the urge to be more passive becomes very strong toward the end of the fifties. To escape the decline in capacity or desire to remain active the individual is apt to take refuge in an intensified program of activities. The desire to make an adjustment is greatest in the late fifties and recedes in the sixties. Seventy-nine per cent of the low income group has not acquired any well defined interest outside their trade, hence they are less able to adjust to retirement.

The attitudes and adjustments of 381 recipients of old age assistance were studied by Morgan (24) in 1933. All the subjects were 70 years of age or more and were described as "mentally normal, self-respecting old people who still lived in the general community and were able to manage their own affairs." Good adjustment and happiness in old age were found to be associated with: "Good health and freedom from physical disabilities. . . . Pleasant social and emotional relations with friends and members of one's family. . . . The possession of hobbies and outside interests. . . . The quiet privacy and independence of action provided by living in their own homes. . . . Some form of work, or useful work-like activity, as distinguished from the more recreational activity of a hobby."

Morgan (24) also concludes that there is no statistical relation between adjustment and the frequency with which old people see their children. Neither was there a significant difference between the happiness score of those who would like to see their children more often and those who would not.

Landis (19) in his Iowa study attempted to determine how dependent aged people differ from the non-dependent aged and what factors make for happiness in old age. He found that nondependent aged people are better adjusted than dependent aged people. Females are better adjusted than males. The more educated are better adjusted in old age than those with fewer years of education. Health is one of the most important factors in adjustment. The feeling of having enough to do each day is also important. Most females at least have enough to do. People with hobbies are better adjusted than those who have none. Those who visit frequently are better adjusted than those who visit less frequently. Activities centering around the home and their children give the aged the greatest pleasure. They enjoyed life most when their children were still at home.

A study of the attitudes and activities of older middle class men and women was made by Gardner (13). One hundred and ninety-three subjects, 72 per cent of whom were 70 or over, were interviewed. Two-thirds of the sample were women. Sixty-seven per cent lived with their children or other relatives; 19 per cent lived with spouses, and 14 per cent lived alone. There were 41 per cent economically independent, 23 per cent partially dependent, and 16 per cent completely dependent.

In spite of the fact that 20 per cent of the replies did not indicate economic status Gardner concludes that happiness has a strong positive relationship to economic independence. Most of the subjects believed that there had been no change in their disposition with age. About 80 per cent had strong social interests. Visiting, listening to the radio, and reading were the most popular activities. There was apparently some correlation between health and happiness. Many of the parents expected their grown children, even though married, to obey them, ask them for advice, or to respect their wishes.

A study of the living arrangements of 498 males and 755 females aged 60 to 100 years was made by Cavan (5). The sample was similar to the general population aged 60 and over, in marital status, in percentage unemployed, and in type of living arrangement. Of import to the present study are Cavan's conclusions concerning 396 males and 483 females who lived in their own homes as compared with other living arrangements. The health of those who lived in their own homes tended to be good. Two-thirds of the men were still employed. Friends supplemented the reduced companionship of the family so that only a few were socially isolated. Women especially filled the day with a variety of activities. Two-fifths to three-fourths of the group had very favorable attitudes in most areas of experience. They were especially well satisfied with economic security, friendship ties, and usefulness.

Both males and females living in rented rooms tended to be less happy, lonelier, and more insecure than those living in their own homes. Old people living in rented rooms were more frequently unmarried, widowers (or widows), childless, and without relatives. They lacked personal contacts, even though many of them were living under one roof, sharing the same halls and stairways.

Discussion

Opinions, such as those by Christensen, Gruenberg, and Cavan (3, 4, 5, 6, 7, 15), based upon casual observations do not, of course, constitute scientific data. But this is not to deny their usefulness. Fre-

quently casual observations suggest hypotheses concerning human behavior which must in turn be subjected to verification by scientific methods.

The studies reviewed herein have emphasized "old age" and are inadequate for the formulation of any valid theories concerning the middle age period. The studies by Morgan, Gardner, Landis, and Cavan (3, 4, 5, 6, 13, 19, 24) do not focus on this period. They are included, however, because they suggest inferences concerning the relationship between adjustment before and after middle age.

Morgan (24), for example, concludes that frequency of contact with the children is not a factor in the adjustment of parents in old age. Gardner indicates that even after the children have married and have families of their own, the parents expect their children to ask them advice. Landis (19) reports that old people consider the child-rearing period the happiest period of their lives. Cavan (5) found that parents supplement the reduced companionship within the family with that of friends so that only a few are socially isolated.

The studies by Deutsch, Fried and Stern, and Fried (8, 11, 12) are the only ones focused on middle age. Deutsch's (8) thesis implies that a significant change in adjustment would occur in middle age; Fried and Stern (12), and Fried (11) also present hypotheses needing verification by other investigators. They found that satisfactory marriages improve or remain satisfactory and that unsatisfactory marriages deteriorate further or remain unsatisfactory. Departure of the children sometimes increases friction and in other cases alleviates it. According to Fried there is a strong desire to eliminate activities in the fifties, but she states on the other hand that the individuals are apt to take refuge in an intensified program of activities.

The foregoing studies have pointed out what happens in old age and implied that what happens in middle age in a large measure determines what adjustments take place in old age. Is the person who has difficulties in later life the one who has had difficulties in interpersonal relations throughout life?

Hamilton (16) stresses the continuity of personality difficulties throughout one's life and maintains that conflicts originate in infancy and childhood, become more serious in adolescence, remain unresolved in adulthood, and become reactivated in old age. Changes in familial relations would seem to be of little significance in such cases, except that certain conditions may operate as catalysts in reactivating former problems.

Frank (10) seems to uphold this point of view when he argues that good social adjustment is primarily a question of how the individual has been able to assimilate his own past experience and come to terms with himself, rather than how the individual has adjusted to external social conditions. Such a view, however, overlooks the fact that "assimilation" takes place within a situation; the individual does not function apart from this situation, instead he functions in terms of it.

Kuhlen (18) posits the theory that motives in a measure cause problems of adjustment. When motives emerge, reach their peaks of intensity, and drop out, the individual must adjust. The problem is more acute if the individual has been dominated by one or a few types of interests; for then when an interest ends, life in a sense ends also.

Two important aspects of the motivation-adjustment pattern among adults are sex and employment. When middle age approaches and introduces limitations on the extent of activity in both areas, problems of adjustment are likely to occur. Since the major function of the family is the rearing of children, their departure from the home terminates the primary common interest of the husband and the wife.

Summary

The behavior observed in the studies reported leads to the conclusion that there is a continuity to personality adjustment within the family, even when the major changes of middle and later life, namely departure of the children, decline in sexual activity, and approaching retirement, demand changes in behavior patterns. This apparent continuity in behavior has resulted in the postulation of theories attempting to account for the deviations which occur. These theories, as summarized in this paper, are as yet somewhat inadequate but tend to emphasize the need for longitudinal studies of personality development from childhood to old age.

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Practices of Minneapolis Firms in the Utilization of Older Employees

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How can the older worker be efficiently utilized in modern industry? How can the individual firm profitably employ older persons in productive capacities? What methods exist for the utilization of older employees in the firm after handicaps associated with advancing age prevent their continued employment at their usual jobs? Answers to these questions were sought by the University of Minnesota Industrial Relations Center in a study of 34 Minneapolis firms in the spring of 1951.

Preceded by an earlier survey of the extent of utilization of older persons by employment in Minneapolis (1, 2, 3), this study was directed toward discovering the processes and methods employed by these 34 firms in utilizing older employees who could no longer handle their regular jobs. All of the 34 firms had either utilized older employees in the past when they became unable to handle their usual jobs or were currently utilizing them. An investigation was made of the methods used in these firms to discover and point out various policies and practices that can be used in other firms as means of continuing the productive employment of older persons.

It is now a well established fact that the population of the United States is aging rapidly. Problems raised by this increasing proportion of older people are numerous. One of them—the place of these older people in our economy—is currently being answered by providing pensions for older employees and removing them from the labor force.

Pension plans and fixed retirement ages are a major factor in the prevention of utilization of older employees who are capable of further work. Pension plans and retirement for older people who are no longer capable of productive labor are a definite part of a complete program of caring for our older people. However, a complete answer would include some system for utilizing those older people who are still capable of working and desirous of work even though they have reached an advanced age. Methods must be found whereby these persons can be employed unless this pool of skill and labor is to be wasted.

The earlier study of 168 Minneapolis firms attempted to describe the extent of utilization of persons aged 65 and over in the city (2). Among other findings, the study found that utilization of employees aged 65 and older was more frequent among those still able at that age to handle their usual jobs. It also showed that, except in firms with compulsory retirement programs, the older person who is still able to perform his usual tasks does not face any serious employment problem on reaching 65. It is rather the person who becomes unable to handle his usual job, or the handicapped older person, who faces unemployment of his remaining abilities. Problems posed by older people still able to perform their usual jobs may largely be solved by abandonment of compulsory retirement ages. Methods for utilizing the remaining skills of those unable to continue at their usual jobs are less obvious and, in the long run, of more importance.

Of the 168 firms in the original study, 73 had had experiences in utilizing handicapped older employees. An attempt was made to follow up on these 73 firms for a more thorough investigation of the utilization methods used. However, in 39 of these firms, the person contacted for an interview stated that firm experience had been so limited—often only one or two cases—that he considered himself unable to take part in a meaningful interview. The present report, therefore, is limited to the follow-up of 34 of the original firms.

Ten of the 34 firms included in the study had pension plans. Thirty-one of the firms were unionized; 28 of the unionized firms had utilized older employees. Further description of these firms is presented below:

TABLE 1. SURVEY OF FIRMS EMPLOYING OLDER WORKERS

Number of Employees	Number of Firms				
	Manufacturing	Wholesale-Retail	Service	Finance	Total
50-99	2	2	1	0	5
100-199	6	2	2	0	10
200-499	11	1	2	0	14
500-over	1	2	1	1	5
Total	20	7	6	1	34

Specific processes and methods of utilization were sought through interview with a member of top management of these firms, or, in some cases, the head of the personnel department of the firm. Interviews took place during November and December of 1950. The interviews were made with a check-list type of questionnaire to aid in categorizing responses. In most cases, questions were asked without reference to the response categories. In some cases, however, where the respondent had difficulty in understanding the type of information sought, the check-list was read to him item-by-item and he was asked to indicate whether or not the method had ever been used. There is the possibility that this use of the check-list resulted in somewhat inflated results—that is, respondents may have replied in the affirmative to items on the check-list even though the method was used only rarely by the firm. Since this study is aimed mainly at finding out how older employees are utilized, this possible error is not a crucial one.

Results

One of the most revealing findings of the study was the relatively undeveloped stage of management thinking about the policies of utilizing older employees. None of the 34 firms has a written policy on the handling of such cases. Two of the firms (6 per cent) stated that part of the policy was written, but this written policy pertained generally to all physically handicapped in one firm and all employees with physical inability to handle the job in the other firm.

Over half of the firms (53 per cent) stated that not only was the policy not written, but there actually was no set policy of any kind. The remainder (41 per cent) stated that although the policy was not written, the same practices had been followed so long that they were known and carried out in the same manner by all members of management and amounted actually to an unwritten policy.

The greatly undeveloped stage of management policy points to the fact that there has been little formal thinking and planning concerning utilization of the handicapped older employee. Fortunately, this lack of formal thinking and planning is not reflected completely in the utilization process. All of the 34 firms were selected because of the fact that they *had* carried on utilization of handicapped older employees. These 34 firms plus the 39 which had carried on utilization but were unwilling to generalize from one or two cases make up 43 per cent of the total of the 168 firms surveyed originally.

Part of any program for the utilization of handicapped older employees must include methods for identifying these people so that appropriate action can be taken. A question concerning this phase of the process in the firms revealed the following:

"How is it first noticed that an older employee is having difficulty handling his usual job?"

While some firms listed more than one method, ranking by percentage of responses indicates that day-to-day observation of the immediate supervisor is the most usual method of notice; 85 per cent of the firms report this method of observation. Excessive absenteeism on the part of the employee was mentioned by 50 per cent of the firms as the method of noticing difficulty of older employees. Employee complaints to management that the job was be-

coming too difficult and excessive illness of the employee were listed by 47 and 44 per cent of the firms. Other methods mentioned were cost control records, complaints from other employees, excessive visits to the plant nurse, and routine physical examination.

A particular instance of how handicapped older employees are first noticed was shown at one firm where the plant nurse reports any older person who visits her office with any regularity. In this case the nurse also serves as an unofficial counselor, and the older employees often tell her of any difficulties they have on their jobs rather than relating them to their supervisors. However, reports in most cases came from the immediate supervisor who noticed that the employee was having difficulty with certain aspects of his job or in keeping up with his production.

The condition is ordinarily not recognized until it has reached quite an advanced stage. Apparently management in these firms is not expecting or looking for a declining ability of older employees to handle their jobs. In no firm was any special attempt made to try to identify these people early in order to take any remedial action which might correct the situation at that time.

More important than the way of discovering the declining ability of an older employee is the actual disposition of the case in such a way that the employee is kept on with the firm in a productive capacity. The following question was asked with reference to past instances of utilization in the firms studied:

"What procedure is followed in attempting to keep these people employed?" (Some firms indicated more than one procedure.)

A reduction of duties of the job without a decrease in pay was the method mentioned by 62 per cent of the firms. Transfer of the employee to a job he can handle *with* an adjustment in pay was mentioned by 50 per cent of the firms; 44 per cent indicated that they transferred the employee to a job he could handle *without* an adjustment in pay. Thirty-eight per cent of the firms mentioned that they had created jobs which the employees could handle as a means of utilization.

Other methods mentioned include reduction of duties on the same job with reduced pay; retention on usual job on a part-time basis; transferral to another job on part-time basis; transferral to a casual labor pool where he is called upon to perform various jobs such as loading and cleaning; promotion to a more responsible but physically less demanding job.

A reduction of duties without an adjustment in pay was the most frequently used method of utilization. In many cases this was quite informal and actually amounted to simply overlooking the fact that the employee was no longer performing all of the duties normally required at the job. In the cases of office or white collar employees, it was found that a younger person was often employed to learn the job and gradually assume the duties of the handicapped older employee. In this manner the older employee was retained at the usual rate of pay until retired. Another example of a reduction of duties is the case of a shop in which heavy electrical equipment was constructed. Here younger employees performed the more strenuous parts of the jobs, such as ladder climbing, relieving the older employees at these duties which all employees would normally perform.

Reduction of hours was found most frequently in small shops. For example, a small cabinet shop allows its older employees to determine their own hours; an older employee reports for work when he feels able and works as long as he wishes. While this type of utilization is restricted to shops where steady production is not important, in several larger firms older employees were transferred to specific part-time jobs; for instance, 2 older employees shared a job, one working in the morning and the other in the afternoon. Transfers to service jobs such as janitor or night watchman were reported more often than transfers to other production jobs.

In a few cases, utilization was really providing the employee with a hidden pension. Several employers stated that since they had no

pension plan, they occasionally kept on older employees at an expense to the company only because they were long-service employees and the company believed that it owed them some sort of pension. Evidently some utilization is caused by an absence of pensions rather than by the interest of the firm in utilizing the still existing skills of their older employees.

To get a picture of the machinery set up in these firms to handle the utilization of handicapped older employees and of the factors influencing the decisions on use of these employees, the following question was asked:

"How is the decision made on action to be taken in utilizing these older employees?" (Some firms gave more than one answer.)

62% Top management is consulted.
47% The immediate supervisor consults with the department head.
44% The personnel department is consulted.
30% A representative of the labor union involved is consulted.

Other methods mentioned include freedom for the immediate supervisor to take action and a special committee which is appointed to handle these cases.

The fact that top management is consulted on utilization in 62 per cent of the firms is an indication of the relative number of cases of utilization; top management can participate in each case of utilization only if the number of cases is small. Furthermore, it is an indication of the stage of policy formation regarding the utilization of older employees; it indicates that an exact policy has not yet been determined and thus top management is consulted in every case.

Two firms had permanent committees which determined whether or not an older employee should be kept with the firm and the capacity he was to fill. In one of these the committee was formed of 4 members of top management and in the other the committee was composed of representatives of management and the employees.

Discussion

Surveys made in 1933 and 1947 by the Metropolitan Life Insurance Company and the National Industrial Conference Board provide comparisons with findings of this study at three points (4, 5, 6).

1. Usual methods of discovering older employees who encounter difficulty handling their usual jobs were the same in 1951 and 1933: notice by immediate supervisor, excessive absenteeism, and excessive illness.

2. Methods of utilization reported by the 3 studies were essentially the same: job transfer, reduction in hours, and a reduction of pay. However, whereas job transfer without adjustment of pay was reported by 44 per cent of the Minneapolis sample, only 10 per cent of the firms contacted in 1947 by N.I.C.B. reported job transfer without an earnings adjustment. The relatively greater use of this method of utilization in Minneapolis may be a result in part of the increased public emphasis on pensions since 1947 and may represent hidden pensions in lieu of actual pensions.

3. Responsibility for utilization was found in 1933 to rest usually with the firm personnel department. The Minneapolis study found the immediate supervisor noticing cases of handicapped older employees and reporting them to top management or the personnel department, with top management then participating in determining the disposition of the cases. Participation by top management is possible only when the number of cases is small; the relatively small number in Minneapolis firms is again a possible reflection of the increased use of pensions. As pension programs become more widespread, more employees are retired before they become unable to handle their usual jobs, thus reducing the number of possible utilization cases.

In general, the comparison of findings of 1933, 1947, and the present study reveals a lack of progress or change in management thinking and planning for the utilization of handicapped older employees. Comparison of the findings of these studies indicates that the picture with respect to methods of utilization has changed little since 1933. Aside from a few widely publicized formal plans for the utilization of older employees, management

policies and practices in utilizing older employees are much the same as they were in 1933. There seems to be little that can be gained from further study of present policies and practices for utilization; rather, industry seems to be in need of information on the problem of utilization in order to form effective policies. More must be known of the limitations and capabilities of older people with respect to employment before intelligent policies and practices can be formed.

The medical profession can aid in the future utilization of handicapped older persons by translating findings of studies of the physiologic aspects of the aging process into terms of motions, exertion, and tasks that are found in industry. A great deal of information about the physiologic aspects of aging is now known, but this technical information is next to useless to the layman attempting to apply it to the selection of jobs for older people. Coordination between management and the medical profession at the level of plant physician and in an advisory capacity is needed for the development of sound utilization programs.

Summary

Perhaps the most revealing finding of this study is that set policies for the utilization of handicapped older employees are almost nonexistent among Minneapolis firms. Apparently no single firm has encountered enough cases of older employeers who have found difficulty in handling their usual jobs to warrant the formation of a definite policy for dealing with such cases; each case is handled individually on its own merits.

All of the 34 firms investigated in this study have utilized handicapped older employees. Methods of utilization employed in these firms were almost identical with methods used in 1933 and 1947; the immediate supervisor, plant nurse, and plant physician play key roles in the informal utilization processes of these firms.

The authors are members of the research staff of the Industrial Relations Center, University of Minnesota, directed by Dr. Dale Yoder. Other staff members who participated in this project were Harland Fox and Josephine Welch.

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Church Membership and Personal Adjustment in Old Age

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Several studies of personal adjustment in old age have indicated that church membership is related to good personal adjustment. The Social Science Research Council Subcommittee on Social Adjustment in Old Age, for instance, found in its study (3) of 2,743 persons above the age of 60 throughout the United States that men without religious affiliations had significantly lower mean personal adjustment scores than the entire group of men and that among the women studied there also was a difference, although it was not so pronounced, the Protestant church members having a higher mean score than women without any religious affiliation.

One of the factors found by Schmidt (8) to be related to poor adjustment among men 50 to 59 years of age was no church membership. Britton's study of 444 retired school teachers (1) revealed church membership to be associated with personal adjustment of both the men and the women. Thus there is a growing mass of evidence that some type of relationship prevails between personal adjustment in old age and church membership.

In the spring of 1950 a preliminary study was made by Moberg (7) to test the hypothesis that elderly people who are church members are better adjusted than those who are not church members. From a group of 68 residents of two old people's homes in the Minneapolis-St. Paul area an experimental design was set up which matched individuals who were church members with those who were not church members at the time of interviewing. Pairing or matching was done on the basis of 9 characteristics (sex, race, age, marital status, education, children, occupation, present employment, and health). Eight pairs of individuals remained after matching.

The mean personal adjustment scores of the 8 church members were higher than those of the 8 non-members, although the differences were not statistically significant, perhaps because of the smallness of the sample. The matching of church members with non-members, however, did result in a decrease in the mean personal adjustment score of the members. This was taken as an indication of the possibility that complete control of all known and unknown influencing factors might completely eliminate the differences of personal adjustment between church members and non-members.

As part of a larger study (7) an attempt has been made to study further the relationship between personal adjustment in old age and church membership. Questionnaires were completed for 219 persons who were residents of 7 institutions in the Minneapolis - St. Paul metropolitan area, 5 of which are homes for the aged and 2 public institutions which care for others in addition to the aged. Included in the questionnaire was the Burgess-Cavan-Havighurst Attitudes Inventory (2), which was used to measure personal adjustment in old age.

In addition to specific information about his religious preference each respondent was asked, "Are you a church member?" If he replied affirmatively, he was asked to indicate the church to which he belonged, and if he replied negatively, he was asked to indicate where and when, if ever, he had been a church member. Verbal responses to these questions were used to classify respondents as church members or non-church members as of the time of interviewing.

The 132 church members in the study had a mean personal adjustment score of 28.4, while the 87 non-church members had a mean personal adjustment score of only 23.3. (A high score indicates good personal adjustment.) The difference between these mean

personal adjustment scores of the 2 groups was statistically significant at the 1 per cent level of confidence.

Table 1 gives further details which indicate that the church members of every denomination represented had higher scores than those who were not church members but expressed a church preference for the same denomination. The differences in scores between religious denominations are believed due to differing characteristics of the homes in which the respondents were living, for each home has slightly different entrance requirements, and to differences in background other than purely religious factors.

TABLE 1. MEAN PERSONAL ADJUSTMENT SCORES ACCORDING TO CHURCH MEMBERSHIP OR CHURCH PREFERENCE

Church Membership or Preference	Church Members		Non-Members	
	N	Score*	N	Score*
All Groups	132	28.4	87	23.3
Catholic	33	25.7	5	15.0
Protestant.	97	29.2	77	24.2
Baptist	17	31.1	6	28.0
Episcopal	33	29.4	4	28.8
Lutheran	22	28.3	41	22.2
Methodist	9	28.7	7	23.6
All other	16	28.6	19	27.3
Christian Science	2	29.5	0	--
None	0	--	5	15.4

*High mean personal adjustment score indicates good adjustment.

The superior adjustment of the church members as compared to the non-church members was still evident when the data were analyzed by sex, females who were church members having higher mean personal adjustment scores than non-member females and male church members having higher scores than non-member males. Similarly in every instance when members were contrasted to non-members within categories of age, nativity, place of residence, years of schooling, marital and family status, self-rating of health, participation in social organizations, and verbal self-rating of happiness church members had mean personal adjustment scores which were higher than the scores of the non-church members. This seems to corroborate strongly the hypothesis that church membership is related to good personal adjustment in old age.

To test the hypothesis more precisely an experimental group of church members was equated with a control group of non-church members by the matching of individuals on the basis of 7 control factors (sex, present employment, club participation in the past and present, marital status, number of living children, education, and self-rating of health). This matching reduced the 132 church members and the 87 non-members to 53 persons in each group.

To increase objectivity and help eliminate bias the hypothesis was tested in the form of two null hypotheses: There is no difference in personal adjustment in old age between persons who are church members and persons who are not church members when other characteristics of the two groups are controlled by matching of the individual members, and the observed differences in personal adjustment in old age between persons who are church members and persons who are not church members but who are similar in other respects are no greater than those differences that could occur between two groups selected by random sampling from the same population.

Matching of the two groups reduced the mean personal adjustment score of the church members from 28.4 to 26.8 and increased that of the non-members from 23.3 to 24.9. The difference between the two scores after matching was not statistically significant. (The test of significance used was the t-test or critical ratio, which was in this instance 1.4, far below the C. R. of 2.0 required at the 5 per cent level of confidence. Calculation of the standard error of difference between means included corrections for the correlation introduced by the matching of pairs.) The first null hypothesis was therefore rejected, for there was a difference between the scores of the two groups, but the second null hypothesis was ac-

cepted, for these observed differences were not statistically significant.

The interesting decrease in the personal adjustment scores of the church members and the increase in the scores of the non-members which resulted from the elimination of cases in the matching process led to an attempt to control even more rigidly the matching of individuals from the two groups. Two more controls were added for the purpose of matching: nativity and the institution in which the individual resided. The sample was reduced by this process to 18 persons, 9 in each group. The increased homogeneity of the control and experimental groups reduced the mean personal adjustment scores of both groups, but the reduction was greater in the experimental group, so the mean scores were almost identical, viz., 24.1 for the church members and 24.2 for the non-church members. Both null hypotheses were therefore accepted, and the basic hypothesis that personal adjustment in old age is related to church membership was rejected.

It is believed that there are at least two possible explanations of the lack of association between church membership and personal adjustment in old age when other factors are controlled by matching: the "quality" of the individual's membership and the influence of the church on non-church members.

The problem of the "quality" of church membership has been recognized in the distinction drawn between "church" and "sect" by Max Weber (6) who said that "sect" membership was a certificate of moral qualification, especially of business morals, for the individual in contrast to "church" membership into which one is "born." Church affiliation hence is basically obligatory and proves nothing regarding the individual member's qualities, but a sect is a voluntary association of only those who are religiously and morally qualified.

From this viewpoint one would expect to find a difference in personal adjustment in old age between those who are "sect" members—those who have joined a church of their own volition—and "church" members who have been born into church-member families and hence quite automatically became members. Yet it must be recognized that even among those who have joined religious bodies of their own volition are many who have done so for various ulterior motives rather than because of true religious sentiments and interests. If there were some way of distinguishing such church members from the others, it might be discovered that there also are other significant differences between the two groups, including differences in personal adjustment in old age.

It should also be recognized, as Cuber (5) has empirically demonstrated for the Detroit metropolitan area, that the church has a great influence on persons who are not members of the church. Many persons attend church services regularly and take part in other of its activities all their lives without ever becoming members in the formal sense of the term. Furthermore, through persons who are church members, the influence of the church is indirectly brought to bear, in varying degrees, upon many secular activities and especially upon ethical and moral standards. It is at present impossible to measure this indirect influence of the church, but it is probable that it is not as great today as it was in the formative years of the aged people who were studied in this project. Hence even the non-members who have had nothing to do with the church directly may have been influenced by the church to some degree throughout their lives. It is possible that this indirect influence of the church over those who are not church members is in part responsible for the lack of significant differences in personal adjustment in old age between those who are church members and those who are not.

In addition many persons become members of churches and then later drop their memberships. Clifton has indicated on the basis of his study of a random sample of old age assistance recipients throughout the State of Minnesota (4) that, although churches hold their members better than other organizations he studied, there are large numbers of the aged who have dropped their memberships. Such persons have been under the influence of the

church, so even though they are not church members in old age they may evince the same type of personal adjustment as church members if church membership is related to personal adjustment in old age. A preliminary analysis of personal adjustment scores of persons with varying types of church membership experiences indicated the possible fruitfulness of exploring these problems further.

As table 2 indicates, it was found that the mean personal adjustment scores of church members who had become church members after reaching adulthood, and hence presumably entirely of their own volition and their own interest in the church, had slightly higher personal adjustment scores than those who had joined the church earlier. Among the non-members, the scores of those who did not indicate ever having been church members were somewhat lower than those who indicated they had been members during part or most of their lives, the mean personal adjustment scores being 21.5 and 24.0 respectively. Is this an indication that if past membership in the church were controlled in the control group of non-church members significant differences in personal adjustment between church members and non-members might be discovered?

TABLE 2. MEAN PERSONAL ADJUSTMENT SCORES BY CHURCH MEMBERSHIP EXPERIENCE

Church Membership Experience	N	Mean Score*
All Persons	219	26.4
All Church Members	132	28.4
Member since age 14 or earlier	69	28.0
Member since age 15 to 20	25	27.6
Member since age 21 or later	26	30.0
Not clearly indicated how long	12	28.1
All Non-Church Members	87	23.3
No membership ever indicated	23	21.5
No church preference indicated	4	15.5
Church preference indicated	19	22.7
Former church members	64	24.0
Member only as a child or youth	22	21.8
Member as a child until an unspecified age	10	23.9
Member during part or most of the adult years	32	25.5

*High mean personal adjustment score indicates good adjustment.

To test that possibility, the 23 non-church members who did not indicate ever having been members were paired by individual matching with the 132 persons who at the time of interviewing were still church members. The 7 characteristics used in matching were sex, education, marital status, number of living children, similarity of club activities in the past and present, self-rating of health, and present lack of employment. This matching process reduced the mean personal adjustment score of the group of church members from 28.4 to 25.5, but it did not affect the mean score of the non-members, which remained at 21.5. The critical ratio of the difference in personal adjustment scores for these 11 pairs of persons was not statistically significant, so the hypothesis that there is a relationship between personal adjustment in old age and church membership was not verified even after there had been a crude refinement of church membership by excluding from the non-church members those who were known to have been at one time or another members of some church.

Case studies of deviant individuals indicated that religion operated in a very important way in the lives of many who were not church members. One man, for instance, had never been a church member, yet in the interview he emphasized the importance of the Bible and indicated by his beliefs in a future life the influence of the Christian religion and the church upon him. Other portions of the study of which this is a part (7) indicated that participation in religious activities was significantly related to good personal adjustment in old age and that the holding of conservative or orthodox Christian beliefs was also related to good personal adjustment for the sample that was studied.

It is probable that many of the studies that have found church affiliation to be related to good personal adjustment in old age have done so only because church membership is frequently related, however inconsistently, to religious activities and religious beliefs which are the true "stuff" in religion that makes for personal adjustment. Many church members

are members in name only and are concerned about the church and its activities seldom except on such occasions as Easter and Christmas, weddings and funerals. Likewise, many non-church members by their active participation in the church's program and adherence to the beliefs it encourages and fosters gain many of the personal and social benefits which flow from the church.

It is therefore suggested that more refined indices of one's religious life and experiences than mere church membership be used in any study which relates religion to personal adjustment in old age.

Summary

In this study of aged persons residing in institutions it was found that initially significant differences in personal adjustment scores between a group of church members and a group of non-church members were eliminated by the application of ex post facto experimental designs equating church members with non-members on the basis of background and other characteristics. Control of past church membership experiences among the non-church members did not greatly modify this finding.

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Retirement in Four Professions

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THIS paper reports on certain aspects of the retirement experiences of four groups of professional men 65 years of age and over.[1] Three of the groups, public school teachers, Methodist ministers, and Young Men's Christian Association secretaries, are salaried workers who retired at or near a fixed age. The fourth group, a sample of physicians, is composed largely of men who could retire or limit their practice at their own discretion as they grew older.[2]

Since the occupational backgrounds of these groups differ, before consideration of the empirical data we shall give a brief description of each profession at the time these men were most active in their careers.

The YMCA Secretary.[3] To the public which sees the Young Men's Christian Association secretary as an administrator, a fund raiser, a hotel executive, or a boys' worker, the status of the secretary may not be clearly defined. To the participants in this study, who served the Young Men's Christian Association in its period of expansion, from 1900 through the First World War and into the present, the YMCA is an institution with a structure of specialized job assignments within which each secretary can make a career for himself.

At the turn of the century, the time that many of our respondents began their careers, the YMCA was interested primarily in supplying religious leadership to young men, especially to young men in the cities. The Association had expanded rapidly in the late nineteenth century as a result of the Bible Study movement. During the period from 1900 to the First World War, the Association was concerned both with meeting the religious needs of young men and with "character building activities," which included body-building activities. A great expansion took place in boys' work, in student work, in the program with working men in transportation and industry, and in work with men in the Army and Navy. From 1900 to 1920, the Association built many of its familiar three or four story red brick buildings in most cities of 20,000 persons and more in the United States.

In its early decades, the Association was truly a lay religious movement, and those men, some of our respondents among them, who embarked on a career as Association executives saw themselves as "called" to a life work. This notion gradually gave way to that of planned professional training, when following the First World War the staff of the YMCA became intensively interested in themselves as educators and group workers. To many of the older men, this was a departure from the historical evangelistic character of the movement. As the educational approach and particularly the concept of group work became current in the Association, the secretaries began to think of themselves as professional specialists operating within a social agency. In 1922, a general plan for the certification of entering secretaries was adopted, and, beginning in 1934, only those applicants who had had a 4-year college education or its equivalent could be certified (13).

The Schoolteacher. The group of men schoolteachers in whom we are interested,

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[1] A general statement of the problems of retirement as they confront the professional worker has been made by Havighurst and Shanas (10).

[2] Some of the material for teachers has been presented, in another form, by Britton (4). Certain of the materials for YMCA secretaries appear in a dissertation by Britton (3). A detailed report on this sample of older physicians is given by Gruen (7). Ruth H. Watson will report on aspects of the experiences of ministers in a dissertation now in preparation.

[3] This discussion of the background of the YMCA Executive Secretary is based largely on material by Pence (13). See also Bartlett, Hogan, and Boyd (2), and Bartlett and Boyd (1). A useful and interesting publication which reflects the feelings and attitudes of our subjects is *The Old Guard News,* published by the International Association of Retired Secretaries, 347 Madison Ave., New York.

while retaining some of the heritage of the country schoolmaster, differ markedly from this stereotype.

The teaching experience of the men in our study has been secured almost completely in an urban school system. These men entered the teaching profession in the beginning of the twentieth century. At this time the secondary schools were mainly selective, college preparatory institutions. The position of the high school teacher carried a higher social status than it does today. Male secondary school teachers were graduates of liberal arts colleges and of universities. They taught physics, chemistry, biology and mathematics, the manual arts, and often history and civics. They were the "experts" of their community, in a day before technology had brought chemists and engineers into every industrial town and city.

Many men in the teaching profession were content to teach in the classroom all their lives, while others went into administrative work, became elementary and secondary school principals, and supervisors in the rapidly growing school system of the 1920's and 1930's.

Teaching which had previously been considered something that anyone with a good education could learn "on the job" and, at its best something of an art, was becoming more "scientific" and professionalized. Those men who took post-graduate training thus studied the "science" of education, although most of them had had their undergraduate training without benefit of courses in pedagogy. The schoolteacher group in contrast to the YMCA secretaries of that time, was definitely a professional group at the turn of the century.

The Methodist Minister. The Methodist ministers in our study are all men who entered the ministry in response to a personal religious experience which they perceived as a "call from God." These men received their "call" to religion as youths and remained in the church from then on. They saw their careers in the ministry as "a dedicated life."

At the time in which our subjects took up their calling, Methodism still had some of the characteristics of a frontier religion. Stories such as this one of the Reverend C. M. Adams were familiar to all of our respondents, and many of them knew older ministers who had had experiences like these.

> The saddlebags were tied on behind the saddle when full, otherwise thrown over the seat of the saddle. They were often used as a pillow at night in the open, with a camp fire at the feet, at which coffee had been boiled and bacon fried.
>
> The outfit consisted of horse, saddle, saddlebags, quirt, lariat and frying-pan, food, Bible and hymn book. Preaching places were school houses or the Court House. School houses were of logs with openings, but without windows and doors, with dirt floors, fire places and slabs for benches. The parsonage had been sold for fifty dollars as I had no bird for the nest. It was loaded on to a lumber wagon, without being torn down, and drawn ten miles to a mining camp. My salary was $150 a year. Board was $3 per week, or $156 a year. The hospitality of the people knew no bounds (12, p. 454).

By 1900 many young men entering the Methodist ministry had a four year college degree and a year or two at a theological seminary, but still some started preaching with no more than a high school education and they gradually added to their training by home study under the supervision of committees of the better-educated ministers and by summer school work. In general, the ministers in the industrial and urban centers had the greatest amount of formal education.

Although young men entered bravely on a "dedicated life" there was a marked awareness in the church that the minister's career often ended in poverty for him or his family. Retirement from the ministry and the provisions for retired ministers and their dependents had been discussed and pondered within the Methodist church more than thirty years before this study was made. As a result, a pension plan for ministers and their widows had been introduced within the career span of our study group.

The Physician. The physicians in our study include both general practitioners and specialists over 65 years of age. In speaking to these men, we were impressed with their strong self-identification with the "profession" of medicine.

A recurrent theme was that they represented an "earlier era" in that profession. Sometimes these physicians referred to the days of their youth as "better times"—not for themselves, particularly, but for the profession.

To understand this point of view, we must realize that even the youngest among our subjects had begun his medical career before World War I. Indeed, some among them had already been students or practitioners of medicine during the last decades of the nineteenth century. Within their own life time, these men had seen great strides in the "professionalization of medicine." The discipline had become markedly more "scientific," the training of students had been elaborated and standardized, and, the period since 1900 had seen the growth of medical specialties. Many of these men considered that "service" was the primary aim of a doctor's career, a concept akin to the "dedicated life" of the Methodist ministers. Some of these doctors saw both the growth of specialization and the increase in the size of medical fees as adverse factors operating to destroy the "dedication" of the physician. Dr. Herrick in his *Memories of Eighty Years* (11), in which he looks back over his 60 years of medical practice, expresses the dilemma which confronted certain of the respondents.

Of his function as a specialist, Dr. Herrick says:

> Yet I had to admit that, no matter how hard I tried, it was impossible to keep pace with the rapid strides made by medicine and cognate sciences. Much of the newer knowledge, so enormous in its mass, eluded me. There was some comfort in knowing that other physicians were in the same predicament (11, p. 156).

Of medical fees, he says:

> During my sixty years of practice a marked change has taken place in the matter of fees charged for medical service. In 1889 the ordinary family doctor asked one dollar of the patient who came to his office. A visit at the patient's home was two dollars.

It is doubtful that any physician would want to return to the medical practices of 1889. The effects of changing practices on the career of the medical man, however, were recognized by the respondents, and for many of them these were a matter of deep concern.

Description of the Study Groups

Adequacy of the sample

No claim is made that the data used in this paper are indicative of the experience of *all* retired persons in the four occupational groups studied.[4] With certain qualifications, however, these data adequately represent the four samples of those occupational groups which we investigated.

The material for YMCA secretaries was secured *primarily* from a schedule on retirement experiences which was sent to members of four of the ten chapters of the International Association of Retired Secretaries.[5] Two hundred and fifty-two men, 77 per cent of the total membership of these chapters, returned their schedules. Following this, a longer schedule, "Your Activities and Attitudes" (5) was sent to these men. One hundred and forty-six men (45 per cent of the total group) returned both the long and short schedules, and certain supplementary data from these long schedules are also reported here. Special comparison studies of respondents and non-respondents indicate that the study group is composed mainly of those men who had devoted a lifetime of service to the YMCA, as is indicated by the length of their employment and their age at retirement, and who, by and large, felt themselves economically secure. Although our group does not represent *all* retired secretaries, it is undoubtedly a good selection of those men who typify the YMCA secretary as he sees himself and is conceived by others.[6]

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[4] A discussion of sampling problems in the study of the aged, including the sampling of the groups of retired schoolteachers and YMCA secretaries used in this study, is given by Havighurst (8).

[5] These chapters are the L. Wilbur Messer, whose membership is drawn largely from the middlewestern states; the McBurney-Morse, with headquarters in New York City; the C. B. Willis, with headquarters in St. Petersburg, Florida; and the Henry J. McCoy, with headquarters in California.

[6] Many of the men who did not reply to our questionnaire had left the "Y" before the age of 60, and

YMCA secretaries retire earlier than any other professional group. At the time of our study, retirement from active duty in the YMCA was arbitrary at the age of 63. In the early 1930's, when many of the older men in our study retired, retirement was urged at the age of 60. YMCA secretaries have a pension system to which they make regular contributions from their salaries, and, although this pension is higher than those of the other groups in this study, this factor is partially offset by the secretaries earlier retirement age and consequent loss of regular salary unless they secure other employment.

The data for school teachers were secured from 153 retired male teachers, who composed 60 per cent of the male annuitants (253) of the Chicago Public Schools in the year 1947.

Certain supplementary data from the "Activities and Attitudes" schedule received from 105 men who returned both the schedule on retirement and the longer schedule are also used where necessary. The 153 participants in this research were unevenly disributed in the kinds of job available within the school system. Sixty-one per cent had been teachers in high school, junior college, or teachers' college. The remainder of the group, with few exceptions, were school principals, supervisors, and other administrators. The group seems to be representative of older men in the school system who are particularly conscious of their role as professional men.

Retirement has been compulsory at age 65 in the Chicago School System for some years, and most of the men in this study retired at this age, although a few retired at their own desire and at a later age before compulsory retirement at 65 was established in 1935. Pensions are paid by a Pension Board and the system is supported by salary deductions and tax monies.

Information for ministers was secured from annuitants of the Board of Pensions of the Methodist Church incorporated in Illinois. The Conferences served by this Board are distributed throughout the country with the exception of the South. Eleven hundred men, 39 per cent of all annuitants (2944) in these Conferences, replied to a schedule. Almost equal numbers of these respondents came from the eastern and midwestern states, and somewhat lesser numbers from the northeastern and the western states. Data available to us indicate that the respondents and non-respondents received about the same pensions, and were alike in other characteristics, with one exception. Respondents had a much higher proportion than non-respondents of men who had retired when they were 65 years of age or more. Our respondents were men who had served until compulsory retirement provisions or poor health had forced them to retire.[7]

The Methodist retirement plans permit retirement between the ages of 65 and 72. The provision of arbitrary retirement at 72 was instituted in 1942. Hence the ministers have an older average retirement age than the teachers and the YMCA secretaries.

Data for physicians came from 138 "Your Activities and Attitudes" schedules received from 38 per cent of a sample of older physicians in the Chicago area who were registered with the American Medical Association.[8] The respondent group includes a higher proportion of older men than did the total sample. However, more of the respondents, within each age group, were still active in the profession than was the case with the men who did not respond to the questionnaire (7). Our subjects, more than a comparable group of medical men of their age, were men who still saw themselves as "doctors."

This close identification of the study groups with their professions was true for all four

did not think of their last major employment as being that of a YMCA Secretary. Further, others among our non-respondents were financially insecure and had largely lost contact with their more secure colleagues. A detailed discussion of the adequacy of this sample is given by Britton (3).

[7] For detailed discussion of the adequacy of this sample see Britton (4).

[8] The original sample was composed of a 50 per cent random selection of all male physicians in the area registered with the American Medical Association.

professions studied. The biases which exist in our sample, therefore, are those which would bring into the study men who might be expected to feel retirement most keenly and directly.

The age distribution of the four groups of participants is given in table 1. The majority of these men were between 65 and 74 years of age at the time of our study. More than half of the teachers, the YMCA secretaries, and the physicians were in this age group. In contrast, the ministers were substantially older, almost one-fourth of them being 80 years of age or more and their average age, 75. The youngest of the four groups were the YMCA secretaries with an average age of 70.

TABLE 1. PERCENTAGE IN EACH AGE GROUP OF PARTICIPANTS.

Age	Occupational Group			
	Ministers	Teachers	YMCA Secretaries	Physicians
	Percentage	Percentage	Percentage	Percentage
Total	100.0	100.0	100.0	100.0
55–59	1.5	.....	1.2	.....
60–64	2.3	.....	14.3	.....
65–69	12.0	41.8	29.0	32.6
70–74	29.0	30.7	26.2	37.7
75–79	30.5	14.4	12.7	20.3
80–84	18.3	9.8	6.3	5.8
85–89	4.5	2.6	2.4	3.6
90 and over	1.9	.7	.....	.....
Not given	.....	.....	7.9	.....
Mean Age	75.0	72.1	70.4	72.1
Number of cases	1100	153	252	138

Our respondents were largely native-born, married, and living with their wives. For the three groups for whom data are available, teachers, YMCA secretaries, and physicians, 80, 91, and 67 per cent, respectively, are native-born.[9] Eighty per cent of these men were married and living with their wives, an exceptionally high percentage for this age group.[10]

WORK AND RETIREMENT

With only a few exceptions (41 former ministers and 39 former YMCA secretaries) all the men in our study were 65 years of age or older. These YMCA secretaries, teachers, and ministers, but not the physicians, were in professions where retirement was compulsory at a fixed age or was determined by an employer. Most of these men then had to interrupt a life-time career at some time between 60 and 70.

Despite this more than half of our subjects (56 per cent) were still employed. The proportion employed full-time varied from 16 per cent among the ministers to 38 per cent of the physicians (table 2). Thirty-five per cent of YMCA secretaries were so employed. These were men who, unlike the physicians, had retired from their life-time occupation and were employed in other lines of work.

Part-time employment was greatest among physicians and YMCA secretaries, least among teachers and ministers. The "occasional" employment reported by ministers (table 2) is almost always preaching as a "supply pastor."

The present positions of the men who were working are given in table 3. Of the three groups of "retired" men, the ministers and teachers tend to continue in their former occupations. Two-thirds of the employed ministers were still in religious work. Many of them were supply pastors, taking the place of other ministers who had to be away from their charge, or preaching in small churches which could not afford to employ a full-time pastor. Half of the teachers who reported employment

[9] While comparable data are not available for Methodist ministers, we would expect the proportions of native-born among the ministers to be at least as high as that of the YMCA secretaries—and perhaps higher.

[10] In 1949, only 64 per cent of all men, 65 years of age and over in the U.S. were married and living with their wives. U.S. Bureau of the Census (15).

TABLE 2. EMPLOYMENT STATUS OF PARTICIPANTS.

Employment Status	Occupational Group			
	Ministers	Teachers	YMCA Secretaries	Physicians
	Percentage	Percentage	Percentage	Percentage
Total	100	100	100	100
Not employed	41	66	41	21
Employed	58	34	56	67
Full time	16	18	35	38
Part time	18	16	21	29
Occasional	22	....	....	....
Degree unknown	2	....	....	....
Information not given	1	....	3	12
Number of cases	1100	153	252	138

were still teaching. In contrast to these, of the former YMCA secretaries, one-fifth were in religious work, one-fifth in "civic" activities, primarily fund-raising, and another fifth were in business. Other jobs of the employed secretaries included lecturing, writing, and reporting. The physicians in our study usually did not need to retire at a fixed age. Despite their ages, 93 of them, two-thirds of the total group, were still working. Although these men had sometimes curtailed the amount of their activity, they had all continued in medicine. While some ministers and teachers, and many YMCA secretaries went into new occupations in later life, no physician changed his occupation.

At this time of relatively full employment in the United States, apparently almost all of these older men who wished to work and were physically able to do so had some kind of job. Only 8 per cent of the ministers, 15 per cent of the teachers, and 10 per cent of the YMCA secretaries who were not working said they were unemployed because they were unable to

TABLE 3. PRESENT EMPLOYMENT OF PARTICIPANTS AND PERCENTAGE IN EACH TYPE OF EMPLOYMENT.

Type of Employment	Occupational Group		
	Ministers	Teachers	YMCA Secretaries
	Percentage	Percentage	Percentage
Total	100	100	100
Religious work	71	...	19
Teaching	...	50	...
YMCA work	...	...	1
Social work	2	...	12
Fund raising, Chamber of Commerce activities	1	...	23
Business	9	27	21
Research and writing	...	6	3
Crafts	2	...	...
Unskilled and semi-skilled	7	...	...
Farm	3	4	...
Other	3	13	20
Information not given	2	...	1
Number of cases	641	52	141

secure a position, or a position they wanted. The remainder of those not working were not interested in jobs.

In our study 1 man in 5 was working full-time, and an additional 2 men in 5 were working part-time. Very few of those in good health were idle. Why do these older men work? In studies of non-professional men, both young and old, they often express the wish "to retire and take life easy." This is usually qualified by the conditions that the man have enough money to live on and something to do in his leisure time. But professional men apparently do not generally wish "to retire and take life easy."

Undoubtedly, some of our study group were working primarily to supplement their retirement incomes. These data were secured from the teachers, ministers, and YMCA secretaries

in 1947. At that time, the average pension paid to men school-teachers in the Chicago system was slightly higher than $1000.00 a year.[11] The average pension of 71 YMCA secretaries retired in the fiscal year ending July 31, 1947 was $1556.00. For 45 of these men with over 30 years of service it was $1967.00 (14). The average pension of the Methodist ministers in our study was $869.00.[12]

These amounts are not very large in terms of 1947 dollars and financial need may be a factor in the continuation of some professionals in employment. The retirement pension constituted three-fourths or more of their total yearly income for 35, 40, and 26 per cent, respectively, of the ministers, teachers, and YMCA secretaries. On the other hand, for one-third of the ministers and teachers and for one-half of the YMCA secretaries less than half of their yearly income was made up by their retirement pension.

Of every 10 ministers or YMCA secretaries, 6 were working either full or part time. Three of every 10 teachers and 7 of every 10 physicians were employed. Yet, there seemed to be no clear relationship between work and economic need. When asked whether they believed they had economic security, 6 of every 10 ministers and teachers and roughly 8 of every 10 YMCA secretaries answered "yes" without any qualification. Two-thirds of the physicians gave this reply also (table 4). Data available to us indicate that many of our subjects, both employed and unemployed, were supplementing their retirement pensions with income from investments and insurance. While financial need certainly played a part in the employment of some of these professional men, it was not the only factor.

Our subjects spent a good part of their leisure-time in reading and listening to the radio,—quiet, contemplative activities.[13] A high proportion of all groups gardened, some did creative writing or painting, and among the ministers, teachers, and YMCA secretaries a great many took part in church work and civic affairs. Among the physicians many took part in or attended the meetings of clubs and other organizations (table 5). The leisure time of most of these professional men seemed to be filled with activities. Whether these activities were satisfying to them or not we cannot tell from our materials.

Studies which have been made by the authors and their colleagues indicate that a man's adjustment to retirement is essentially an adjustment to the loss of the satisfactions that work has for him. One's occupation may assume for him a variety of different meanings some of which are related to his personality structure and other of which arise from the cultural setting. For some, work may be primarily a way of earning a living, for others the primary

TABLE 4. PERCENTAGE DISTRIBUTION OF OPINIONS ON PRESENT ECONOMIC SECURITY OF PARTICIPANTS.

Opinion	Occupational Group			
	Ministers	Teachers	YMCA Secretaries[1]	Physicians
	Percentage	Percentage	Percentage	Percentage
Total	100	100	100	100
Feel economically secure	62	63	75	65
Do not feel economically secure	24	34	13	17
Questionable	9	2	6	....
Opinion not given	5	1	6	18
Number of cases	1100	153	146	138

[1] Data from sub-sample of secretaries who returned both short and long schedules.

[11] Computed from data in Reference 6.

[12] Computed by Ruth H. Watson from data furnished by the Board of Pensions of the Methodist Church, incorporated in Illinois, and included in her dissertation now in progress.

[13] These data were gathered before the recent wide spread of television.

TABLE 5. PROPORTION OF SUBJECTS REPORTING "SOME" OR "A GREAT DEAL" OF TIME SPENT IN VARIOUS ACTIVITIES.

Activity	Occupational Group			
	Ministers	Teachers	YMCA Secretaries	Physicians
	Percentage	Percentage	Percentage	Percentage
Gardening	64	69	59	35
Reading	90	97	92	78
Travelling	51	77	66	4
Participation in civic affairs	39	61	60	16
Participation in church work	82	52	79	....
Painting, writing	27	33	31	23
Radio listening	77	90	77	54
Participation in older people's groups	40	40	57	....[1]
Participation in clubs and organizations	17	41	....[1]	33
Number of cases	1100	153	252	138

[1] Not available.

function of the job is that it fills the day and makes a tolerable routine. For some persons work may be a source of self-respect or a means of securing the respect of others. Others see work as an opportunity to be with people.

Some people find in their work primarily a source of new experiences. Certain personality types, for example, the artist, may see their work as a chance to be creative. Still others may see their work as a way of being useful to others, and others see it as a source of power.

All of these themes were developed by our respondents. For example a retired YMCA secretary expresses the service motive when he says, "[as a salesman], I make and find opportunities daily to be helpful to people. I love to make friends." Similarly a physician reports "What I get out of my practice is the satisfaction of helping people and seeing them helped." A "retired" teacher who is still teaching says "I'm as happy as ever. I love my work." Another physician when asked "Do you want to retire?" answered, "I have enough money to retire but I don't know what I would do. There are only two things I know—farming and medicine. I have been practicing medicine so long that I don't think I'd like farming."

These professional men have highly favorable attitudes toward work. On a scale for measuring work attitudes 47 per cent of the teachers, 46 per cent of the YMCA secretaries and 62 per cent of the physicians made the highest possible scores on favorable attitudes toward work.

The average attitude scores secured on the Activities and Attitudes test may be used as a measure of adjustment. These range from a high of 43.6 for YMCA secretaries, the youngest group, to a low of 38.1 for ministers, the oldest group. Teachers and physicians had almost the same scores, 40.2 and 40.1. These scores for professional men are higher than the mean attitude score, 37.7, of a cross section of the male Louisville population, reported by Kutak,[14] and 38.0, the mean for a sample of older men in a small town, reported by Havighurst and Albrecht (9).

The data given here together with the detailed interviews and comments made by these men give us some insights into retirement as it affects the professional worker. It is apparent many professional men want to continue to work after the usual or expected retirement age of 65. Most of these men who want to work do so in some capacity or another. Continued work after retirement is not necessarily related to either economic necessity or to a desire to fill in "empty time."

It is clear that professional men do not retire if they can help it. Among our subjects only the physicians were able to choose their

[14] Personal communication from R. I. Kutak, University of Louisville, Kentucky.

own time of retirement. Most of these doctors continued to work long after they reached the arbitrary retirement ages of the other professionals.

Retirement Policy

From these materials we may raise the general question, when is the best time to retire? If the experience of our subjects is a criterion, the answer seems to be "any time but 65." If a man wants to work as long as possible at his present occupation, 65 is too young for him to become inactive. Many men would welcome retirement at 70 who object to it at 65. On the other hand if a man wants to start a new "post-retirement" career, 65 is too old to retire. The YMCA secretaries who retire at 63 and sometimes even younger found that their work opportunities were better than those of other men who retire at a later age.

The testimony of these professional men is clearly in favor of flexible retirement plans, tailored to fit the man's health and his values in life. Most of them do not like compulsory retirement at an arbitrary age. But if there is to be such a plan, they favor an age later than 65. From the experience of the ministers who had more flexibility and from experience of groups with later arbitrary retirement ages (not described in this report), it is the opinion of the authors that 68 would be a fairly good age for compulsory retirement of professional men if any arbitrary age is to be selected.

Considering the values and the desires of the elderly professional men of today, the conclusion must be that work offers more satisfaction to those in fair health than do the substitute activities which they have or which they can imagine.

Summary

The authors studied the experiences of four groups of professional men: public school teachers, Methodist ministers, Young Men's Christian Association secretaries, and physicians, all of whom, with the exception of 39 YMCA secretaries and 41 ministers, were 65 years of age and older. The members of the first three groups were all nominally retired from their lifetime employment. The average ages of these men ranged from 70 years for the YMCA secretaries to 75 for the ministers.

More than half of the men studied (56 per cent) were still employed. The proportion employed full-time varied from 16 per cent among the ministers to 38 per cent of the physicians. An analysis is made of some of the reasons why these men work after the usual retirement age. Continued work after retirement is found to be not necessarily related to either economic necessity or a desire to fill "empty time." Professional men are found not to retire if they can avoid it.

From the materials the question is raised, when is the best time to retire? A flexible retirement plan is preferred, and, if an arbitrary age is to be used, the age 68 is suggested.

This study was aided by a grant from the Carnegie Corporation of New York. That Corporation is not, however, the author of this report and is not to be understood as approving by its grant any of the statements made or views expressed therein.

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Submitted for publication November 28, 1952

The senior author's address is:

DR. ETHEL SHANAS

UNIVERSITY OF CHICAGO

COMMITTEE ON HUMAN DEVELOPMENT

CHICAGO 37, ILLINOIS

CURRENT COMMENT

New Institute of Gerontology

Creation of the Iowa Institute of Gerontology—an information center on problems of aging—was announced early in January by State University of Iowa President, Virgil M. Hancher.

The new Institute will serve as a research station and service center to pool resources and work toward the solutions of the problems of the 1 out of 9 Iowans over 65 years of age. The Institute will also collect data in such areas as financial resources, employment, housing, recreation, family life, and religious expression, making such data available to anyone seeking information along those lines.

An outgrowth of discussions by state leaders attending the first Iowa Conference on Gerontology at the University last November, the Institute's creation takes action for the aging population from the "talking stage" to the "task force" organization stage.

The 100 or more representatives attending the November conference at the University heard experts from various fields discuss problems of the aging population. Among these conferees were physicians, social workers, labor leaders, religious leaders, industrialists, recreation leaders, and educators.

It was pointed out at the conference that Iowa's small villages and rural non-farm areas have the largest proportion of the over-65 group. On farms, 6.2 per cent are over 65, while in urban areas over 2,500 population, the proportion is over 10.7 per cent.

The two-day conference ended with a promise by University of Iowa officials that immediate action would be taken toward establishing an institute for further study of the problems of aging. Approval of the Iowa Institute of Gerontology by the Iowa state board of education climaxed the recommendation by conference representatives.

Although a director for the Institute has not yet been named, a committee is already at work making plans for operation of the new unit.

Pre-retirement Program

The Industrial Relations Center of the University of Chicago, through its Older Worker Project, is planning a pre-retirement program for industrial employees. The program is to be built around a series of conferences for older workers, in which group participation and problem-solving are emphasized. Materials for the program consist of booklets on various aspects of aging and retirement, written guides for conference leaders, and visual aids. The basic material in the booklets is written by experts, while the editing and the design of self-checking lists and other learning aids are handled by the Older Worker Project staff. The guides, prepared by the Older Worker Staff, are for use by conference leaders, who are industrial rather than university personnel and who receive training from the University in conference leadership. The guides utilize such learning techniques as role-playing, visual aids, question-and-answers, and free discussion. Attendance by participants will be voluntary, and wives of participants will be invited to attend.

Studies in Retirement

The Industrial Relations Center of the University of Chicago has recently completed a cooperative arrangement with the Institute of Gerontology, University of Florida, and the Moosehaven Research Laboratory, Orange Park, for the purpose of studying the retired worker and his problems of adjustment upon migration to a new locality, such as Florida. Dr. Ernest W. Burgess, Professor Emeritus of the Department of Sociology, University of Chicago, has joined the staff of the Industrial Relations Center as Consultant, and is also directing the retired worker studies in cooperation with the University of Florida. Underway are studies of the adjustment of persons who have moved to Florida after retirement compared with the adjustment of persons who have remained in the same location after retirement. Other topics, including the adjustment to trailer-living, are anticipated.

Gerontologic Conferences and Seminars

The Tenth Annual Meeting of the American Geriatrics Society will be held at the Hotel Commodore, New York City, May 28-30, 1953.

The establishment of the JOURNAL OF GERONTOLOGY was made possible by a grant from the Josiah Macy, Jr. Foundation.

The hieroglyphics, "The Beginning of the Book for Transforming an Old Man into a Youth," at the top of this editorial page, are from the Edwin Smith Surgical Papyrus, translated by Professor John Breasted, University of Chicago Press.

The University of Michigan will hold its Sixth Annual Conference on Aging, July 8 to 10, 1953. The topic of the conference will be "Earning a Supplemental Income after Retirement." The program will include a survey of the problem and the barriers to its solution; an evaluation of the psychologic, sociologic, and economic gains of continued employment; methods for developing opportunities to earn; and demonstrations of successful enterprises by older people themselves. The University is eager to learn of outstanding examples of successful older people in different parts of the country with a view toward bringing a few of them to the conference. Names of such people should be sent to the conference chairman, Dr. Wilma Donahue. The conference is open to anyone wishing to attend or participate, and programs can be secured by writing the conference chairman.

State Conferences of Social Work in Arizona, California, and Virginia will each devote two or more sessions to problems of aging. The Arizona meeting will take place April 29 to May 1, 1953, at Tucson. The Virginia meeting will be held at Roanoke, April 30 to May 1, 1953, and the California meeting at Fresno, May 4 to 6, 1953.

The Third Annual Southern Conference on Gerontology was held in Gainesville, Florida, January 26 and 27, 1953, under the auspices of the University of Florida Institute of Gerontology, the Medical Center Study Group, the General Extension Division of Florida, and the St. Petersburg Times and Radio Station WSTP. The purpose of the conference entitled, "Florida Plans for a Healthy Senior Citizen," was to examine the role of gerontology and geriatrics in modern medicine and to identify the implications for a modern medical school and health center program. Participants in the conference included Dr. Edward L. Bortz, Philadelphia; Dr. Frank Sladen, Detroit; Dr. E. W. Burgess, Chicago; Robert M. Ball, Baltimore; Dr. R. W. Kleemeier, Orange Park; Dr. A. I. Lansing, St. Louis; Dr. N. W. Shock, Baltimore; Dr. R. A. Moore, St. Louis; and Dr. William Sanger, Richmond. In addition, deans of southern medical schools and members of the Florida Medical Association attended the conference.

Some 80 persons have enrolled for a 15-week seminar on "Living in the Later Years" conducted by the Federal Security Agency for the benefit of staff members who wish to plan for a healthy, happy, and secure retirement. The Seminar is a pilot project to work out methods and procedures. Subject matter covered includes health, biologic, and psychologic aspects of aging, emotional problems, living arrangements, income maintenance, and other topics. Three of the weekly sessions will be devoted to demonstration projects of various forms of creative activities.

A seminar on problems of aging has been organized by the Welfare Council of Metropolitan Chicago. Participants are board members and directors of homes for the aged and representatives of welfare agencies. Over fifty organizations cooperate in a plan which attempts to hold each meeting at a different home for the aged in the metropolitan area. Thus participants have an opportunity to tour various institutions as well as discuss with invited speakers some aspects of aging, e.g., the problem of the mentally confused resident in a home for the aged.

An institute on "Aging Persons and their Families" was held at the Loyola University School of Social Work, Sept. 17 and 18, 1952.

A panel of speakers on the first day outlined the physical, emotional, and social factors related to aging persons and their families. Two concurrent sessions were held on the second day, on services to the aging and their families by institutions and by community agencies. Forty-two agencies from Illinois, Indiana, and Wisconsin were represented at the Institute. Publication of the Institute material is under consideration.

A Round Table on Problems of Retirement will be held at the meetings of the American Psychiatric Association in Los Angeles in May, 1953. G. Hamilton Crook, Else Frenkel-Brunswik, Mason Haire, and Oscar J. Kaplan have been invited to serve as discussants. Clark Kerr, Chancellor of the University of California at Berkeley, will be Moderator.

Films

The Seventh Age is a 17-minute production showing community-supported housing developments and life therein in Denmark. It should be widely used by State and local Committees on Aging and by groups responsible for building and operating facilities for congregate living. Available at the Danish Information Office, 588 Fifth Avenue, New York 36, New York.

Retire to Life, released by the National Film Bureau, 6 N. Michigan Avenue, Chicago 2, deals primarily with need for activity and recognition in retirement, but touches also on related matters of financial security, three-generation family living, and medical care. It was produced by the Oklahoma State Health Department and the University of Oklahoma and will probably become available through State health or

mental health departments, State mental health associates, film libraries, and through the Mental Health Consultants in the Regional Offices of the Federal Security Agency.

Looking Ahead is a 13-minute documentary picture showing the role of Old Age and Survivors Insurance in providing financial security to workers in retirement and to survivors. Produced by the Social Security Administration, it is available through local or regional Social Security offices.

The McGraw-Hill Text-Film Department has issued a film entitled *Organic Reaction-Type: Senile.* It is one of a new series of films produced by the National Film Board of Canada for the Canadian Department of National Health and Welfare.

Gerontologic Notes

Massachusetts is the only state at the present time with a law which makes discrimination in the employment of persons age 45 to 65 an unfair employment practice. As a result of this law the Massachusetts Commission Against Discrimination has ruled that pension plans with a compulsory retirement age of less than 65 are inoperative and in violation of the State law.

New Yorkers over 60 years of age will again have the opportunity of publicly displaying their talents and handiwork when the Welfare and Health Council of New York City holds its Seventh Annual Hobby Show for Older Persons, May 21-31, at Education Hall, American Museum of Natural History, 77 Street and Central Park West.

Research Fellowships in Gerontology

The Merrill-Palmer School, 71 East Ferry Avenue, Detroit 2, Michigan, has announced a number of fellowships for graduate training in gerontology. The fellowships are open to graduate students with a general background of training in psychology, human relations, family life and related fields. The program will give special emphasis to the problems of later maturity and their relation to human development in the family setting. Investigations of new methodological approaches suited to the education of the aging and the aged are planned. The Merrill-Palmer records on children and their families afford an excellent opportunity for longitudinal studies. The program will be directed by Dr. David F. Kahn.

New Journal in the Field of Geriatrics

The *Journal of the American Geriatrics Society* began publication with the January, 1953, issue, as the official publication of that Society. The Journal is published monthly by the Williams & Wilkins Co., Baltimore.

ORGANIZATION SECTION

E. V. COWDRY, *President*
660 Kingshighway Blvd.
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Baltimore City Hospitals
Baltimore 24, Maryland

ANTON J. CARLSON, *President-Elect*
University of Chicago
Chicago 37, Illinois

JOHN ESBEN KIRK, *Treasurer*
5600 Arsenal Street
St. Louis 9, Missouri

GERONTOLOGICAL SOCIETY, INC.

Membership Account

For the year ended December 31, 1952

Balance January 1, 1952			$ 1,076.31
Receipts:			
Memberships	$ 2,676.56		
Subscriptions	10,595.37		
Partial Reimbursement for Fifth Annual Meeting, Washington, D. C.	983.00		
Total Receipts		$14,254.93	
Disbursements:			
Transferred to Journal Account	10,611.37		
Fifth Annual Meeting (Washington)	2,051.26[1]		
Refunds on Registration for Second International Gerontological Congress	447.04		
Printing and Stationery	415.33		
Postage	314.37		
Contribution to National Society for Medical Research	100.00		
Audit	30.00		
Sixth Annual Meeting (San Francisco)	7.50		
Miscellaneous	15.57		
Total Disbursements		13,992.44	
Excess of Receipts			262.49
Balance December 31, 1952			1,338.80

GERONTOLOGICAL SOCIETY, INC.

Journal Account

For the year ended December 31, 1952

Balance January 1, 1952			$ 4,595.36
Receipts:			
Subscriptions and Back Issues	$ 19,002.30		
Advertising: 1951 $ 321.92			
1952 843.39	1,165.31		
Reprints: 1951 779.38			
1952 5,669.44	6,448.82		
Excess Engraving & Tabular Matter			
1951 434.21			
1952 1,258.81	1,693.02		
Color Plate, January Issue	771.50		
Washington University School of Medicine Grant for Support of Second International Gerontological Congress	2,000.00		
Total Receipts		$31,080.95	

[1] Includes payment of $270.11 to Federal Security Agency personnel for operation of press room.

Disbursements:			
Printing & Mailing Journal (including color plate)	14,015.92		
Reprints	5,276.09		
Salaries	4,620.00		
Office Equipment	480.41		
Postage	388.97		
Office Supplies, Printing & Stationery	210.63		
Telephone & Telegrams	131.80		
C. C. Thomas for 1946 Back Issues	73.08		
Publicity	57.69		
Audit	30.00		
Express	23.31		
Refunds	17.20		
Copyrights	16.00		
Revue Médicale de Liège	8.20		
Total Disbursements		25,349.30	
Excess of Receipts			5,731.65
Balance December 31, 1952			10,327.01
Recapitulation:			
Cash in Bank			$10,277.01
Petty Cash on Hand			50.00
			$10,327.01

1952 ANNUAL REPORT OF THE MEMBERS OF THE GERONTOLOGICAL SOCIETY, INC., PURSUANT TO SECTION 46 OF THE MEMBERSHIP CORPORATIONS LAW OF NEW YORK

TO THE MEMBERS OF THE GERONTOLOGICAL SOCIETY, INC.:

The members of the corporation submit the following report for the year ended December 31, 1952.

(1) Real Property	$ 0.00		$ 0.00
Personal Property:			
Cash deposit in the First National Bank:			
Membership Account	$ 1,338.80		
Cash deposit in Boatmen's National Bank:			
Journal Account	10,277.01		
Petty cash fund	50.00		
Office furniture (St. Louis)	650.00		
Estimated value, back issues of the Journal of Gerontology, 1947, 1948, 1949, 1950, 1951, and 1952 St. Louis)	7,150.00		
Total			19,465.81
(2) Receipts: The amount and nature acquired during the year ended December 31, 1952:			
Membership dues	2,676.56		
Subscriptions to the Journal of Gerontology	18,986.30		
Advertising, reprints, excess engraving and tabular matter in the Journal of Gerontology	10,078.65		
Washington University School of Medicine grant for support of the Second International Gerontological Congress	2,000.00		
Total			33,741.51
(3) Disbursements: The amount applied, appropriated or expended during the year ended December 31, 1952:			
Printing and mailing Journal	14,015.92		
Reprints	5,276.09		
Salaries	4,620.00		
Fifth Annual Meeting (Washington, D. C.)	1,068.26[1]		

[1] Includes payment of $270.11 to Federal Security Agency personnel for operation of press room.

Postage	703.34	
Office supplies, printing and stationery	625.96	
Office equipment	480.41	
Refunds	464.24	
Telephone and telegrams	131.80	
Contribution to National Society for Medical Research	100.00	
C. C. Thomas for 1946 back issues	73.08	
Audit	60.00	
Publicity	57.69	
Express	23.31	
Copyrights	16.00	
Revue Médicale de Liège	8.20	
Sixth Annual Meeting (San Francisco)	7.50	
Miscellaneous	15.57	
Total		27,747.37

(4) Summary:

Cash balance on hand January 1, 1952	5,671.67	
Receipts during year ended December 31, 1952	33,741.51	
Disbursements during year ended December 31, 1952	27,747.37	
Leaving a balance of		11,665.81

(5) The names and places of reidence of the persons who have been admitted to membership in the corporation during the year ended December 31, 1952:

(None)

Dated January 31, 1953
State of Missouri } ss.
City of St. Louis

Ernest W. Burgess and John Esben Kirk, being severally duly sworn, each for himself says: That the said Ernest W. Burgess was President, and that the said John Esben Kirk was Treasurer of the Gerontological Society, Inc. for the year 1952; that the foregoing is a report thereof showing the whole amount of personal property owned by said corporation, where located, and where and how invested; the amount and nature of the property acquired during the year ended December 31, 1952, being the year immediately preceding such date, and the purpose, objects, or persons to or for which such applications, appropriations, or expenditures have been made; the names of the persons admitted to membership in the corporation during the year; and that the corporation owns no real property; which report is in all respects true to the best of deponents' knowledge and belief.

Ernest W. Burgess, *President*
John Esben Kirk, *Treasurer*

GERONTOLOGICAL SOCIETY, INC.

Balance Sheet
December 31, 1952

Assets

Cash in Banks	$ 11,615.81	
Petty Cash on Hand	50.00	
Total Assets		$11,665.81

Liabilities

None		-0-

Net Worth

Balance January 1, 1952	5,671.67	
Net Income for Year	5,994.14	
Balance December 31, 1952		$11,665.81

BOOK REVIEWS

RHEUMATIC DISEASES, DIAGNOSIS AND TREATMENT, by Eugene F. Traut, C. V. Mosby Company, St. Louis, 1952, 942 pages, $20.00.

This textbook constitutes a valuable contribution in the field of clinical medicine. The particular importance of the book in the reviewer's opinion lies in the fact that it deals not only with the more serious, classical lesions of the joints, but also with the less invalidating but very common, ordinary disease conditions of the ligaments, bursae, and fasciae. In the experience of the reviewer these latter conditions are encountered in about 40 per cent of patients admitted to medical services and are seen with at least the same frequency in general practice. It is therefore very satisfying to be presented in Traut's textbook with a comprehensive description of the symptoms, signs, and histologic pathology of a disease condition like fibrositis.

A characteristic and significant feature of the book is the inclusion of many signs and symptoms, which, although frequently encountered in patients with rheumatic diseases, are not mentioned in the usual medical textbooks. These latter clinical signs are in a most competent way correlated to the pathology of the lesions and integrated with the usual clinical description of the diseases. The fact that nearly all the chapters in the book are written by the same author makes the content well balanced and the acquisition of it by the reader easy and pleasant. The literature references listed in the book seem to be well selected; the great majority refer to publications in American journals.

Since many of the diseases of the joints and ligaments occur with increasing frequency after middle age, the book as a whole should be of considerable value to physicians active in the field of gerontology. Of special interest to this group of physicians are the sections on senile osteoporosis and degenerative arthritis, which are very instructive and reflect the great experience of the author.

J. E. Kirk

UNDERSTANDING OLD AGE, by Jeanne G. Gilbert, The Ronald Press Co., New York, 1952, 422 pages, $5.00.

The organization of this book makes it suitable as a textbook for college courses on aging wherein the psychologic changes of later life are emphasized. It will also be of use to professional persons dealing with the broad problems of aging individuals. There are three major divisions to the book: "Normal life changes in aging," "Abnormal life changes in aging," and "Professional work with the aging." Each of the chapters in these divisions contains a bibliography; a detailed, fifteen-page subject index permits easy reference to the many aspects of aging discussed in the text.

The content of the volume is broad and includes the psychologic, physiologic, and physical changes of aging. However, emphasis is given to the psychologic and psychosomatic aspects. The author has included material on the medical problems of aging since she believes them necessary to understand the changes which occur with age, e.g., in the intellect, emotions, and even in the social relations of older persons. Thus the approach of the author is gerontologic in that she attempts to include the contributions of all disciplines or subject matters. This approach will find many sympathetic readers who believe it unprofitable to fragment the aging individual and parcel out problems among the various scientific and professional specialties. This places a heavy burden on the author as it assumes mastery of a vast literature and an ability to synthesize a coherent story from all the facts written in jargons of the many professional journals.

In view of the breadth of the book, it is unreasonable to expect all topics to be uniform in factual content, conceptual organization, technical level of exposition, and critical evaluation. And in fact the chapters are not uniform in quality. Where the author's mastery is weak or facts sparse, an overly didactic tone has been adopted.

It was necessary for someone to write the first textbook on psychosomatic or psychologic gerontology. For her boldness in filling the need for such a book, Dr. Gilbert will have to withstand the criticisms of biologic, medical, and social scientists who will find many details of their subjects in a new context. Later authors will be grateful that the first book of this type has been written, forming as it will a basis for comparison and discussions about how information on aging should be organized.

J. E. Birren
University of Chicago
Chicago, Illinois

SOME OBSERVATIONS ON EXECUTIVE RETIREMENT, by Harold R. Hall, Harvard University Press, Boston, 1953, 298 pages, $3.75.

The executive approaching retirement should take a far from dim view of this book because it is essentially a poll of his economic peers, gathered, analyzed, and skillfully presented by a competent former colleague with a flair for this type of research. These facts, it should be clear, make for a more palatable dose of good-for-what-ails-you than the equally sound didactics of psychologists, sociologists, social workers, gerontologists, and maybe a few others.

The target bracketed in this book is a minute neglected minority who are too often forgotten out of a feeling that money solves all problems. These men deserve the attention given in this thoughtful, brisk book. Despite the stresses of modern business, executives are sharing in the longevity that is aging

our population. The problem is the more difficult because of the typical executive's extraordinary drive to continue working, an almost compulsive drive.

In the main, the class of citizen discussed answers the economic question: their subsistence is fairly well taken care of, since pensions average from $7,900 to $20,000 a year for the higher paid men. But others are as low as $1,000, so the Social Security benefit is by no means ignored as a supplemental income. Many executives say they liked the idea of "getting back something for the heavy taxes paid in the past."

Executives are not exempt from the vaguely troubling anxiety of all retirement: how to fill the days with interest and usefulness. The prescription, as always, is advance preparation for a suitable activity, plus emotional preparation. This can well be difficult for the man who is accustomed to carry a heavy responsibility and who has much thought and imagination invested in the job he hesitates to give over to another hand. Mr. Hall makes a forceful case for company encouragement of retirement planning and preparation on the part of its executive ranks—company health requires it.

Besides activities, other matters are pointed out for early thought: a place to live, the wife's part and burden, social and economic consequences. One of the best suggestions made by Mr. Hall, based on illustrious examples, is that the retired executive devote a large share of his time to civic service, volunteer work of various kinds in the community—serving on committees, social agency boards, city, county, and state planning groups, the manifold unpaid duties that somehow succeed in advancing our civilized American way of life. The reservoir of skill, experience, and judgment of the executive group should be available for these community enterprises. The point is, of course, that such work, to be rewarding, should be begun before retirement.

This book is valuable, and it would be good for the country if it could be read by those for whom it is written.

Another subjective point may be added: no one wishes to be a bore any more than he wishes to be bored; the facts and advice in this book could help the executive fulfill both wishes upon retirement.

L. Towley
School of Social Work
Washington University
St. Louis, Missouri

MORBUS ALZHEIMER AND MORBUS PICK, A Genetic, Clinical and Patho-Anatomical Study, by Torsten Sjögren, Hakon Sjögren, and Ake G. H. Lindgren; Ejnar Munskgaard, Copenhagen, 1952 (Acta Psychiatrica et Neurologica Scandinavica, Supplementum 82). Translator: Donald Burton.

This treatise on the "diseases" known by the names of Pick and Alzheimer, as its subtitle indicates, consists of three independent but closely inter-related monographs. The first is a genetic-statistical analysis of 80 cases of Pick-Alzheimer syndrome, the second a clinical analysis of the same group, and the third discusses the patho-anatomic findings in 36 of these cases (18 classified as Alzheimer's, 18 as Pick's). These studies have been well conceived, well executed, and the cooperative effort obviously made it possible for each of the workers to pursue his investigation further than he might have without exchange of data during progress of the work. For example, the fact that H. Sjögren found certain hitherto neglected or unobserved clinical differences between Lindgren's histopathologically verified and differentially classified cases of Pick's and Alzheimer's disease permitted T. Sjögren to divide a "Pick-Alzheimer syndrome" group on grounds of clinical findings for more exact genetic-statistical study.

The genetic-statistical study offers much valuable data, e.g.: the average age of onset for these diseases is about 55 years, of death about 62 years; the average expectation of life for a person affected by one of these diseases is about seven years; the morbidity risk for this syndrome in parents and siblings of affected persons is greater than in the general population. The mode of inheritance could not be determined in the study.

The clinical analysis reveals aspontaneity is predominant in Alzheimer's disease in contrast to the view of some that hyperactivity helps differentiate it from Pick's. In addition to the well-known dementia and aphasia in Alzheimer's disease, the author notes a peculiar Parkinson-like disturbance of gait and muscle tonus not found in cases of histo-pathologically verified Pick's disease; these signs may serve as valuable differential diagnostic criteria. The reviewer can recall two of his own cases (one clinically called Pick's, at autopsy Alzheimer's) in which these signs were present and could have been of value in making the correct diagnosis. Lindgren's patho-anatomic differentiation between the diseases depends on the presence of circumscribed cerebral atrophy in Pick's, whereas in Alzheimer's it is relatively diffuse, and on the basal ganglia changes which are regularly seen in the latter but rarely are seen in Pick's. Also, fibrillar changes and argentophil plaques are present in Alzheimer's disease but are never found in Pick's; ballooned cells are absent in Alzheimer's but are regularly found in cases of Pick's disease. The pathologic entities can be correlated with distinct clinical pictures.

This work is explicit, detailed, and contributes valuable statistical, new clinical, and helpful neuro-pathologic data to our knowledge of these diseases. The bibliography is excellent.

A. I. Goldfarb
New York, New York

VIVRE AGÉ SANS DEVENIR VIEUX, by Bernard Desouches, Editions du Rocher, Monaco, 1952, 238 pages, 420 francs ($1.35).

The author of this semi-popular book on aging is Directeur Technique de la Société d'Études et de Recherches pour l'Alimentation Rationnelle (S. E R. A. R.) and one of France's foremost investigators in nutrition.

Desouches' little book makes a valiant attempt to discuss the high points in gerontologic research, to be a handbook of gerontotherapeutics and a manual of physical and moral hygiene. The author's enthusiasm has produced a very readable outline. The discussions of the main fields of gerontologic research are connected with the personalities involved. No attempt is made to evaluate the work described. A semi-popular book of this type may be used to develop interest in aging research and such is obviously so in this case. A very fair coverage of contributions from all parts of the world is given.

Desouches' chief interest is in the field of nutrition in its relation to aging. His treatment of vitamins and minerals is based on animal and clinical work. Recommended usages of these substances in attaining and maintaining "a healthy fifty years" is in accord with many investigators in the aging field. General acceptance of Desouches' suggestions is a matter of dispute among gerontologists, depending upon personal biases as well as interpretations of scientific evidence. This book could very easily become a subject of controversy if its purpose were misunderstood by investigators. All that Desouches' says, in effect, is that this is where we are today, and differences of opinion is due to the low state of the art, rather than Desouches' personal viewpoints.

The discussions of physical and moral hygiene cover generally accepted principles that have psychologic and aesthetic values, if nothing else. Anyone following the gerontotherapeutic suggestions of Desouches will not be worse off, and probably better off in most cases.

The relationship of some of the degenerative diseases and nutrition is not as clear cut and final as stated (p. 89). A few errors of fact are present, and sometimes opinion is given greater weight than scientific evidence. For example, the metabolism of alcohol requires a higher level of B-vitamins intake to maintain a normal physiologic state rather than actually destroying the stored B-vitamins (p. 105). Also the hexose in glycogen is glucose, not fructose (p. 184).

This book is more optimistic in tone than similar attempts in America. The development of public interest in aging research will most certainly result in more books of this type. Desouches' book is a stimulating and suggestive work. It points the way we are heading in some of our research programs, and although only tentative conclusions are possible today, eventually recommendations may be made X years from today that will fulfill a need even more satisfactorily than this book has attempted to do.

T. S. GARDNER
Rutherford, New Jersey

BOOKS RECEIVED

Books received since January 1, 1953, are acknowledged in the following list. In so far as space permits, some will be selected for review in a later issue.

Annotated Bibliography of Vitamin E, Volume II, 1950 and 1951, Distillation Products Industries, Rochester, New York, 106 pages, $2.00. Distributed by the National Vitamin Foundation Incorporated, 150 Broadway, New York 7, New York.

Diseases of Metabolism. Detailed Methods of Diagnosis and Treatment, third edition, edited by Garfield G. Duncan, W. B. Saunders Company, Philadelphia, 1952, 1179 pages, $15.00.

Economic Security in Old Age, Connecticut Farm Operators—1951, Preliminary Report, by Walter C. McKain, Jr., Elmer D. Baldwin, and Louis J. Ducoff, Storrs Agricultural Experiment Station, College of Agriculture, University of Connecticut, Storrs, Connecticut, September, 1952, 23 pages, paper bound.

Found Horizons for the Aging, by Grace C. Hildenbrand, New York City Home for Dependents, Welfare Island, New York 17, New York, 1952, 20 pages, paper bound.

Hospitalization of the Aged, by John J. Griffin, Bureau of Old Age Assistance, Board of Public Welfare, Somerville 43, Massachusetts, 1952, 51 pages, paper bound.

Maimonides: Ueber die Lebensdauer, edited and translated by Gotthold Weil, S. Karger, Basel, 1953, 59 pages, paper bound, $2.25. Distributed by Albert J. Phiebig, P. O. Box 352, White Plains, New York.

Nutrition and Diet in Health and Disease, sixth edition, by James S. McLester and William J. Darby, W. B. Saunders Company, Philadelphia, 1952, 710 pages with 14 figures and 145 tables, $10.00.

Some Observations on Executive Retirement, by Harold Hall, Harvard University Press, Boston, 1953, 298 pages, $3.75 (reviewed in this issue page 228.

Understanding Old Age, by Jeanne G. Gilbert, Ronald Press Company, New York, 1952, 422 pages, $5.00 (reviewed in this issue, page 228).

Vivre Agé sans Devenir Vieux, by Bernard Desouches, Editions du Rocher, Monaco, 1952, 238 pages, 420 francs ($1.35) (reviewed in this issue, page 230).

INDEX TO CURRENT PERIODICAL LITERATURE

NATHAN W. SHOCK
Gerontology Section
National Heart Institute
National Institutes of Health

The subject categories are those in *A Classified Bibliography of Gerontology and Geriatrics* by Nathan W. Shock published by Stanford University Press, Stanford, California (1951). Only major headings are used and the Roman numerals correspond to those given in the bibliography. In so far as possible, references are classified according to organ systems. Thus most of the material on Geriatrics will be found under the organ system involved in the disease. Cross references are indicated by number at the end of each section. When available, abstract references are given *(B.A.—Biological Abstracts; P.A.—Psychological Abstracts;* and *P.I.—Population Index).* Abbreviations for journals are those used in *A World List of Scientific Periodicals Published in the years 1900-1933,* 2nd Edition. For journals not listed, abbreviations were devised according to the general rules used in the above source. It is impossible to cover all journals and list all papers concerned with aging and the aged. Authors and publishers are requested to call attention to publications or to send reprints to the Gerontology Section, Baltimore City Hospitals, Baltimore, Maryland. The assistance of the Forest Park Foundation, Peoria, Illinois, in the preparation of these materials is gratefully acknowledged.

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(includes sex glands and climacteric)

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Muscular System

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X. Nervous System (neurology)

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See also No. 8478.

XI. Reactions of the Body as a Whole

(allergy, anoxia, anesthesia, anthropometry, drugs, exercise, immunity, sleep, and temperature regulation)

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XII. Reproductive System

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